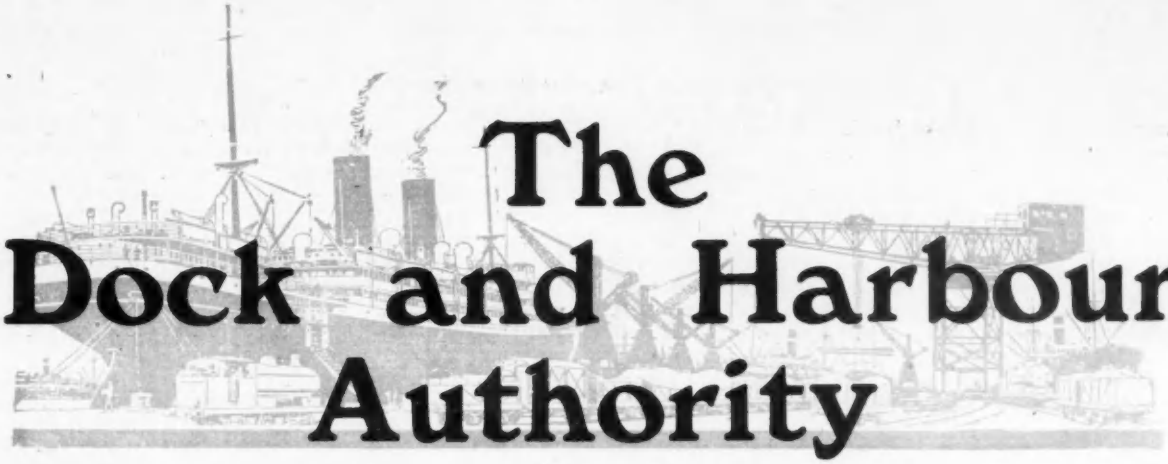

The Dock and Harbour Authority

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Editorial Comments

New Year's Greeting.

Once more, at this season of the year, we have the privilege—as also the pleasure—of extending to all our friends and readers, many of them resident in distant parts of the world, warm and cordial greetings, with best wishes for their welfare in the coming twelve months. It is true that the political sky of the future is still overcast with clouds, but they are not anything like so menacing as they have been in the past since the outbreak of war, and we can now clearly see signs of rifting, with unmistakeable promise of brighter and better world weather which indeed, we hope will gradually spread and extend till it encompasses the whole horizon.

It would not be becoming on our part to touch upon political aspects of post-war problems, except in so far as they affect port affairs, and here the position is by no means sufficiently clear to enable anything very definite to be said. But great and important changes are undoubtedly impending, some of which may materialise before the year 1944 has run its course. For instance, no little significance attaches to the announcement, recently made, that five well-established shipping lines, engaged in the British South American trade, are forming a separate company for the purpose of operaing air services in addition to their normal shipping business, the intention being to offer passengers and freight the alternative of sea-ship or air-ship transport, as may be considered desirable. Such a move indicates the imminence of a profound revolution alike in shipping and port policy, of which it is unavoidable to take note. But we cannot enlarge upon it here. For the moment we must content ourselves with expressing in general terms a confident belief in a revival and the future prosperity of world trade, and in particular in the continued development of port operations in the capable hands of their present administrators.

The Port of Cleveland.

The Port and City of Cleveland, Ohio, fifth city in point of importance and population in the U.S.A., is nearing the 150th year of its existence, and in the relatively short time of a century and a half in the history of modern civilisation, it has risen from a mere pioneering settlement to a position of very great importance among the inland ports and trading centres of the United States.

This is the more remarkable in that the shipping season on the Great Lakes is very restricted and averages only seven months annually. This has proved, however, sufficient for a considerable freight movement, principally in iron ore, coal and steel. Situated between the iron regions of Lake Superior and the coal and ore regions of Pennsylvania and Ohio, by means of its great railway ramifications it has become the largest ore market in the world, and is now equipped with a great and important installation of ore handling plant. The port also handles considerable quantities of lumber and grain. As a shipbuilding centre before the war, more merchant vessels were built at Cleveland than at any other American shipbuilding centre. The article in the current issue provides an interesting survey of the port's activities, together with an historical sketch of the development of the city from the time of its original foundation by Moses Cleaveland in 1796.

The Port of London and its Overseas Trade.

Amid the multiple pre-occupations of politicians over post-war problems of housing, employment, social services and the like, it is eminently desirable that their, and public, attention alike should be drawn to the primary and fundamental consideration on which all such schemes of amelioration must depend, viz. the replenishment of the national purse; because, without adequate financial backing, none of these post-war ideals can possibly be realised. Indeed, the national income must not merely be restored, after a prolonged period of waste and depletion, to its former level of mere sufficiency for national needs, but must be raised to fresh heights of potentiality and scope. The termination of the war will find the United Kingdom a sadly impoverished nation, with an enormous, and even alarming, burden of debt and the country will be hardly put to it to regain those sources of income which have been lost during the internecine struggle, while, if it is to compete at all effectively with other nationalities, it will have to find new markets for the goods which it manufactures and engage in fresh enterprises of a remunerative nature. It was under such circumstances as these, that at the end of November, the London Liberal Party organised a Conference of Business Men, Merchants, Shipping Magnates and others to discuss measures to maintain that healthy overseas trade which is essentially necessary to Great Britain for her future welfare and prosperity.

Without entering into a discussion on the numerous ramifications of the general question, which would lead us into regions requiring expert knowledge, we would draw the attention of our readers to the particular importance attached by two of the leading speakers

Editorial Comments—continued

at the Conference to the pre-eminent position of the port of London in international trade. Both Sir Eric Macfadyen and the Rt. Hon. Thomas Wiles, Chairman of the Port of London Authority, enlarged on the world-wide activities of the port, and showed the unique and outstanding influence which it has hitherto exercised in British commerce. Restriction of space forbids the inclusion of both these Addresses in the current issue of this Journal, but our readers will be glad to have the Address delivered by Mr. Wiles, and this will be found on a subsequent page.

There will be general agreement that London has played a great and significant part in the development of British overseas trade, more particularly perhaps, as regards imports, and is therefore entitled to claim a leading rôle in the revival which all British people hope to see within the next few years. Not unnaturally, some of the other British ports would like to be able to participate to a larger extent in the trade of which London has acquired the lion's share. Mr. Wiles dealt with this point, and argued that the future prosperity of Britain and the Empire is linked to the international trade of the Metropolis, giving various reasons connected with commercial operations for this contention. The unbiassed observer will feel that trade naturally gravitates to its most convenient centres and that it is open to all ports to offer their own specially attractive features, and this, no doubt, they will continue to do, it is to be hoped with satisfactory results to themselves and the nation at large.

The United States Army and Port and River Works.

To the average English engineer it must seem strange and a little incongruous that the development of rivers and harbours, even for strictly commercial purposes and in peace time, should be in the hands of the military authorities. It is a practice peculiar to the United States, and has evolved out of conditions which obtained many years ago.

It will be of interest to our readers to peruse the interesting account of the inception and development of this system, as set out in an Address delivered recently to the Institution of Civil Engineers by Major-General John C. H. Lee, of the United States Army, which will be found in a subsequent page of this issue.

We do not propose to discuss the advantages and disadvantages of the arrangement, still less to offer anything in the nature of criticism upon it, since it appertains to the domestic policy of a friendly and allied nation. To English ideas, as noted above, it undoubtedly appears anomalous, partly, no doubt, because it is unfamiliar, though it will be readily admitted that an engineer *is* an engineer, whether his duties be military or civil; and provided his training has been suitable for the purpose, there is no reason why he should not engage in any form of constructional operations whatever.

The many successful and outstanding achievements of the United States Army Engineer Corps in the field of civil engineering are adequate testimony to the competence and efficiency of military control in what are normally in this country considered purely civil affairs.

The Salvage of Ships and Cargoes.

The fifteenth Report (Price 3d., published by H. M. Stationery Office) of the Select Committee of the House of Commons, on National Expenditure deals with the subject of the Salvage of Ships and Cargoes, a matter in which port authorities have an occasional, though, admittedly, not a widespread, interest. Our readers will hardly need reminding that wreckage precautions and warnings are functions of harbour masters in general, and that harbour authorities (as also the Corporation of Trinity House) are under the necessity of taking steps to deal with submerged wrecks in channels and navigable waterways. In August and September 1941, there appeared in this Journal, a couple of articles dealing with ship salvage in harbours and docks.

But ship salvage embraces a much wider field than can be comprised within harbour limits. The majority of marine casualities occur in exposed positions on the coast line, remote from sheltered waters. None the less the question of salvage, as was evidenced in the articles cited above, necessarily affects harbour authorities, and they have to take cognizance of methods and plant available for the purpose of wreck removal and in certain cases for the recovery of vessels and their freights.

Unfortunately, (or ought we to say, happily?) the infrequency of wrecks in harbour precincts has rendered it unnecessary in most cases for port authorities to include in their establishments much equipment for salvage purposes. A good deal of such work is performed by private firms under contract and there are one or two well established companies who have made a speciality of it, notably the Liverpool and Glasgow Association to whose activities allusion is made in the report.

The Report is mainly concerned with the provision of requisite appliances and labour at short notice in sudden emergencies, and the Committee have had to admit that at the outbreak of the present war, the resources at the disposal of the Admiralty, even with outside help, were lamentably insufficient. After the last war, most of the necessary equipment had been disposed of, and even sold at ridiculously low prices. Since then the Admiralty have had to acquire new plant at a cost to the taxpayer of well over £3,000,000, and the Committee have been concerned with the problem of its utilisation and maintenance in serviceable condition when hostilities have ceased and there is no longer occasion for its frequent use. This, however, is more a matter of national policy which lies outside the immediate purview of this Journal.

In one respect the report touches definitely on port affairs. It is the recommendation (e) in the Report that the Admiralty should give opportunities to British port and harbour authorities to charter Admiralty rescue tugs, and this, no doubt, will be duly noted and acted upon as occasion may require. Emergencies for the prompt exercise of deep rescue work arise from time to time, and local resources may prove insufficient to deal with them. The availibility of Admiralty plant under such circumstances will undoubtedly be beneficial and welcome.

Military Opinion on the Port of London Dock Strike.

In connection with the recent strike of dock workers at the port of London arising out of a demand for extra pay for certain alleged "danger work" which, in default, had to be undertaken by the military, the following caustic expression of opinion from North Africa, as it appeared in a recent issue of *The Journal of Commerce*, makes instructive reading.

" Sir,—I have just read that some of the Thames-side dockers have been on strike because they thought that they were not getting enough money for work that they considered dangerous. Soldiers had to be called in to move vital war stores and food for the people of London.

" Out here we just don't understand this sort of thing. Last week I lost one of my oldest and dearest friends. He died somewhere north of the Volturno River. He died on dangerous work, attacking a German strong point. He destroyed it before he died, but he didn't get any extra money for dangerous work.

" Last week I was out in the desert, up at Alamein. The desert was very empty, very peaceful, and we were alone save for a long row of white crosses along the ridge. The flower of Britain sleep along that ridge, and all along the road from Alamein to Tunis. They died on dangerous work, but they did not ask, or expect, any extra money.

" I repeat that out here we just don't understand these strikes. We have only one aim—to finish the war and get home to our families as soon as possible. To us strikes seem to delay the war and help the enemy.

" I write this on Armistice Day. For us out here and for very many at home it is a day of sad and precious memory. But I'm awfully glad that I will not be on strike on Armistice Day.

Yours, &c., ' RIFLEMAN,' London Rifle Brigade."

A question asked in Parliament elicited the statement from the Secretary for War that five men were injured while carrying out the work referred to. The men were ordered to do the work as part of their military duty, he explained, and they received no extra pay for it.

The fact, regrettable as it is, that injuries were actually incurred while carrying out the work, should not be allowed to obscure the consideration that such risks are taken daily and hourly by the men in all H. M. Forces. The action of the group of London dockers in making the matter a subject for the demand of extra pay lowers the incident from the status of a patriotic enterprise, gallantly undertaken, to the level of a mercenary bargain for extracting a few additional shillings in pay.

The Port of Cleveland, Ohio, U.S.A.

Modernisation of an Important Inland Port*

By GEORGE B. SOWERS.
Chairman of the Cleveland Port and Harbour Commission and Consulting Engineer in charge of Harbour Improvements.

Historical.

AT Cleveland's centennial in 1896, our martyred President William McKinley said: "The statistics of population of Cleveland, her growth and wealth, do not and cannot tell the story of her greatness." True, indeed, an array of figures cannot describe the will of Cleveland's citizens and their spirit in support of civic betterments and especially, their intent on providing adequate facilities for water-borne commerce.

It was Moses Cleaveland, the surveyor for the Connecticut Land Company, who came to the site of this port in a canoe on July 22, 1796. He was impressed with the potentialities of the location and directed the plotting of the tract comprised of "a piece of land designed for a town, probably equal to a mile square bounding west on the River and north on the Lake." Cleaveland came from Canterbury, Connecticut, and after his task was finished, he returned to his native State never to see the rapid growth of the urban centre he surveyed. He modestly reported upon his return: "While I was in New Connecticut I laid out a town on the banks of Lake Erie, which was called by my name, and I believe the child is now born that may live to see that place as large as Old Windham."

Mr. GEORGE B. SOWERS.

Historically, Cleveland was a focal point in the opening of the West. After the fall of Quebec in 1760, the vast region was under the British until 1783. Upon conclusion of peace with the Britannic Majesty, the smouldering difficulties between the colonies and the crown were revived as arguments between the states and the confederation of the U.S.A. Congress held Indian grants and took measures to obtain ceding of lands with some semblance of bargain and sale. Connecticut, after being ousted from her Western Pennsylvania pretentions, pressed claims to territory further west and secured on Sept. 14, 1786 a tract as large as her own metes and bounds in the north-eastern part of what is now Ohio. It was to become the Western Reserve.

In October 1786, the Connecticut legislature passed a resolution authorising a committee of three to sell that part which lay east of the Cuyahoga River at 3 shillings per acre. It seems that no effort was expended in surveying then but by a later resolution from that legislature, a committee of eight was formed representing every county and it was empowered to sell 3,000,000 acres next west of Pennsylvania for not less than $1,000,000. On Sept. 5, 1795 a sale was concluded and the Connecticut Land Company formed. It was for this organisation that Moses Cleaveland set forth.

By 1797, the Company had a road surveyed and partly worked from Cleveland to the Pennsylvania line and by the end of that year, 15 rude cabins had sprung up along the Cuyahoga River. The first grist-mill was grinding in 1799 and the first saw-mill was operating the next year. By 1800, the little settlement was so active that it was made a port of entry. The predictions of the Connecticut promoters that it some day would be "as large as Windham, Conn." were coming to pass.

River Improvement.

The first attempt to improve the river is disclosed in an old letter which was written by Amos Spafford, the surveyor, to "Honl. Turhand Kirtland" and dated Feb. 26, 1807:

". . . agreeable to my Ingagement, I Now Inform you That The Lottery is granted for Raiseing the sum of Twelve Thousand Dollars for makeing a harbour at the mouth of Cuyahoga & opening the communication to the Tuscarawas.

"The Greatest Difficulty now is to make Sale of the Tickets (which will be out in About six weeks) I want you Shoud, if possible make such Arangement as to have a considerable part of The money Raisd by selling the Tickets in Connecticut. This is a matter of so much Consequence to this place and the Adjacent Country that I think you will not hesitate to Imploy some part of your Time to affect the Accomplishment of—it would be well to make some Inquirey for a man to Superintend the Business of Building the pier—a man who is thoroughly acquainted with the Business and Can come well Recomened as a Faithfull Industerous man Calculated to Oversee & Drive Business—and one who has knowledge of the Machine for Driveing Spiles & Building water Craft suteable to Erect it on—this is the man that we shall Want to Imploy & the provability is that we Should want him on The Ground by Christmas Next or before—in Ordr to have the plan Adjusted &c—I hope you'll make your Self Interested in This business."

Harbour Development.

The initial expenditure of the Federal Government on the harbour came in 1825 with $5,000—hardly a munificent sum in the in the light of present day port improvements. Then, the successful operation of the Ohio Canal in 1827 was the real start of the city's boom. The harbour obtained many other improvements and the traffic on the Great Lakes jumped by great leaps. The railroads came and industries expanded. Cleveland became a metropolis and a premier port. But let's get down to what has occurred within the last few years and specifically in 1940.

Cleveland Harbour is located on the south shore of Lake Erie at the most southerly point on the Great Lakes. The harbour development consists of 5 miles of outer harbour, protected by breakwater and an inner harbour consisting of 6½ miles of river channel. The lower portion of the river is a winding channel from which the Indian name Cuyahoga is derived. The channel is generally 200-ft. or more in width and has a depth of 21-ft. at low water. All new docks and structures are being built for a 24-ft. depth of water corresponding to that of the new channels between the Great Lakes.

Recent Bridge Reconstruction.

The navigable channel of the Cuyahoga River is crossed by 27 bridges of which 6 are high level viaducts providing at least 97-ft. clearance above low water. The full improvement contemplates the replacement of some 10 highway and railway bridges of which the 3 most necessary have been completed.

*Reproduced with slight adaptation from an article in *World Ports*, February, 1941. In connection with the American terms and phraseology employed, it is necessary to remember that the word "dock" has a different signification from that generally understood in this country. It can better be expressed by "wharf" or "jetty": it does not mean an enclosed water area. As regards the tonnage figures, it is not clear whether these are "long" (i.e., avoirdupois, 2,240 lbs.) tons or "short" tons (2,000 lbs.), which are commonly used in America.

Port of Cleveland, Ohio, U.S.A.—continued

The building of the City's portion of the plan for improving the Cuyahoga River by easing the bends, widening the channel and removing or replacing old and obstructing bridges, adopted by the City Council Jan. 13, 1931, and approved by the Secretary of War Mar. 13, 1931, has been substantially completed through the expenditure of about $6,000,000. The Federal Government is now undertaking the dredging of the several widening cuts pursuant to the authorisation of Congress. The structures of the present improvement which are most evident to the public are the 3 new, fast-moving vertical lifting-type of highway bridges; that is, the kind where the entire river span lifts like a window between towers 132-ft. high. These 3 bridges replace an equal number of very old, slow-moving and worn out swinging bridges. Two of the new bridges have a clear channel 200-ft. in width while the third has 220-ft.

These 3 new street bridges permit vehicular traffic to move faster and easier on the main highways of the valley. Each new bridge has a 4-lane roadway, with sidewalks on both sides of the bridge. The wide navigation channels of the new bridges permit the boats to move at full speed through the bridges, thereby cutting the time in half that traffic is delayed while the bridges are open.

The 3 new highway bridges were opened to traffic about the middle of 1940. One bridge was built by the Wisconsin Bridge and Iron Co. of Milwaukee, one by the Mt. Vernon Bridge Co. of Mt. Vernon, Ohio, and the other by the R. C. Mahon Co. of Detroit.

Each of the new bridges cost approximately $850,000. The very latest designs and developments have been incorporated. It requires only 1½ minutes to raise the new bridges to their fully opened position, 97-ft. above the water, and the cost for the electric power consumed is only about 7c. The City's municipal electric power plant furnishes the power normally used to move the bridges, but a large gasoline engine is provided for use on each bridge, should the electric power fail.

Everything practical has been done to safeguard roadway traffic. Before a bridge can be opened, a traffic light at each end turns red and a gong rings; railroad type warning gates, with flashing red lights lower across the roadway and finally a cable net barrier is lowered, completely blocking the roadway. These cable barrier gates were tested by driving a loaded truck into them while travelling 25 miles per hour. The cable net barriers keep traffic from driving into the river when the bridge is up and do it in a relatively safe manner.

There can be no sticking or binding of the new bridges due to a moving of the towers. The foundations for the new bridges are all carried down to and into solid rock, a depth of 106-ft. to 175-ft. below water level. In addition each pier is strongly braced by 16-in. steel pipe, batter piles extending out and deep under the river bottom. Each bridge tower rests on 6 steel and concrete cylinders, 30-in. in diameter and designed to carry up to 2,370,000 lbs. of load. The caissons and sockets in the rock were inspected by an engineer lowered to the bottom of each socket in the rock. Although 36 caissons were sunk through putty-like clay, sand and gravel and large flows of natural gas and water were encountered, no lives were lost on the work.

The current vogue for 2-toned colour schemes has been followed in painting the bridges. The main parts of the bridges are a dark green, non-fading, lead colour while the houses and tops of the towers are a light green. The roadway floor over the river on two of the new bridges is an open, steel grating. This eliminates snow, ice and rain and makes the pavement less slippery. The other bridge has a concrete floor. The bridges are well lighted at night with the newest type of white-way street lights.

A new 6-lane highway viaduct ½ mile long was also completed this past year, over the river valley with 97-ft. clearance above the water. This bridge, with its approaches, cost $7,200,000. It is a link in one of the principal defence highways and connects the lake-front highway on either side of the river.

Channel Widening.

While about half of the total money spent on the improvement has been used in providing the new highway bridges to facilitate the moving of vehicular traffic on the streets, the widening of the river channel itself, performed by the Great Lakes Dredge & Dock Co., is of tremendous importance.

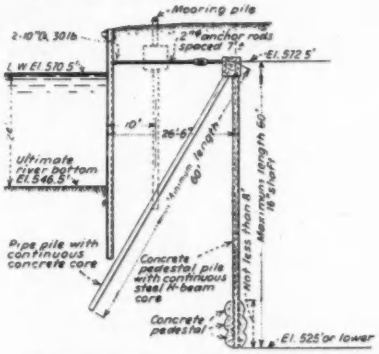
View on Cuyahoga River, Cleveland.

Port of Cleveland, Ohio, U.S.A.—continued

the river and "luck." The big ship may have got stuck in the narrow draw of one of the old bridges, or blocked across the channel at one of the sharp bends, thereby losing several hours' time. It has occasionally happened that one of the old highway bridges broke down, thereby blocking the channel for several hours. To answer the question, and based on good luck, it has required 5 to 6 hours' time for a 9,500 ton, 512-ft. ship to travel the 5½ miles of winding channel. With the 3 old, narrow and uncertain bridges replaced by dependable, fast-moving bridges having 200-ft. wide, clear openings between pier fenders, the removal of other bridges and with the easing of the sharp bends and widening of the channel, the time will be cut in half or even less.

Another important advantage gained through the improving of the river will be the reduction of the height of the water during floods. The widening of the channel and the removal of 4 narrow, centre-pier bridges will greatly increase the flood water capacity of the lower river and should materially lower the maximum height of any flood through the great industrial area of the valley.

The Federal Government has completed the dredging of several cuts at a cost of approximately $106,245 for the removal of 320,000 cu. yds. of earth and sand. Another contract has been entered into for the removal of 346,000 cu. yds. of earth and sand, at a cost estimated to be $124,560.



Cross-section of bulkhead showing A-frame type of anchorage used where buildings were close to the river and where high loads were to be held.

Future Work now Planned.

The City Council has authorized the enlarging and bulkheading of the present Turning Basin to be paid from the City's portion of the unused funds provided for the project through the sale of river improvement bonds. The plans and specifications for this work have been completed and a contract for the work has been entered into.

The new river channel, when the dredging has been completed by the Federal Government, will have a width generally of not less than 200-ft. at points where there are no unloading docks, and 250 to 300-ft. at points opposite the unloading docks, with the points of the bend cut back to permit the passage of the largest boats on the Great Lakes.

The water in the present channel is maintained by the Federal Government at from 21 to 22-ft. deep throughout the entire 5½ miles of channel.

The major portion of the improvement of the navigation channel of the Cuyahoga River authorised by the people in 1931 is substantially completed at a cost of about $5,200,000 and considerably under the project estimate. For the City there remains only the completion of one cut and the building of a new, low-level, Main Ave. Bridge which will require approximately $2,000,000 of additional funds.

Commerce of the Port.

Cleveland's harbour is one of the large ports of the U. S. During the 7-month period of the average shipping season, the tonnage handled in Cleveland Harbour will about equal that handled in the Ports of Boston, Philadelphia or Baltimore during an entire 12-month season.

Almost 17,500,000 tons of freight valued at more than $230,000,000 passed through the Port of Cleveland during the season of 1937 in 5,312 vessels.

The iron ore and steel business represents 80 per cent of the tonnage that clears through the port. Lake coal is now only about 10 per cent of the tonnage. The shipments, by water, of oil, gasoline and chemical products are increasing in amount each year.

The principal commodities handled through the port of Cleveland are:

Iron Ore about 11,500,000 Tons; Limestone about 1,500,000 Tons; Iron and steel about 1,000,000 Tons; Oil and gasoline about 1,000,000 Tons; Coal about 1,800,000 Tons; Paper, chemicals, automobile, grain, food products and misc. about 700,000 Tons.

With the increasing demand for steel and the improving of the Great Lakes, St. Lawrence Seaway it is expected that the commerce handled through the port will be increased to over 30,000,000 tons in a season.

Half of the present water-borne commerce of the harbour moves over the river channel and the proportion should greatly increase with the completion of the improvement. Some of this freight is loaded on railroad cars for use in other cities, but much of it is consumed in local plants with the resulting products being shipped to all parts of the world.

Cleveland is the centre of the country's great industrial area. It is the collecting and distributing centre for 3,000,000 people. It is likewise itself a big consumer of finished products. A large flour mill was located on the river harbour recently after a thorough study had convinced the western owners that Cleveland was not only a big consumer of flour but also a distribution centre for a great consuming area. This same reason has made the harbour a distribution centre for gasoline and fuel oil.

Terminals, docks, warehouses and transit sheds are available for shipside use with cranes and stevedoring services. These facilities are amply served by 6 trunk line railroads and a network of splendid highways.

A ship load of 80,000 bu. of potatoes is being successfully marketed this winter (1941). The big hold of one of the smaller ore handling boats was loaded with potatoes at a Lake Huron port and moored in the Cuyahoga River. The water provided excellent cold storage facilities. The boat crew operates the sorting and bagging machines as a winter job. Trucks haul the graded product away. The operators hope to market several boat loads of potatoes in this way during another winter. It provides winter use for the ship and jobs for the crew.

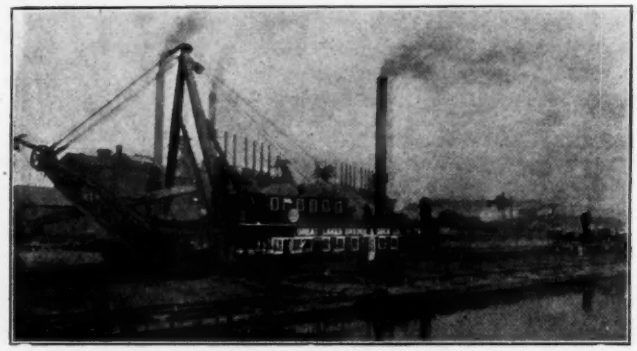
The improvement of the river will make available splendid, large sites for steel mills, blast furnaces and factories in the upper valley, while excellent sites are now available for the smaller factories, warehouses and material docks where the new steel bulkheads have been built along the widened channel of the lower river.

On account of the narrow, winding channel, there has been very little mooring of boats in Cleveland Harbour during the winter months. The vessel operators estimate that each boat "laid up" in a port will spend from $5,000 to $25,000 on repairs and new equipment during the winter months. Safe, winter-mooring docks are now available along the river for some twenty large boats which will bring much new business and winter employment to the community.

The word "Cuyahoga" is the Indian expression for "crooked" and the river has certainly been well named. For the past 50 years the people of the community have been talking about the straightening of the Cuyahoga River. Instead of making the river one straight line, the sharp bends have been cut far back and the channel widened, so that the largest boats on the Great Lakes, which are 635-ft. long, 70-ft. wide and carry 14,000 tons, can navigate the river with safety and at reasonable speed. The improvement will permit the largest boats to deliver the iron ore, limestone, oils and gasoline directly to the plants and docks in the upper valley, a distance of 5½ miles from the mouth of the river. Through "streamlining" the river instead of straightening it the entire objective has been accomplished wihout seriously interfering with the industries in the valley or the loss of valuable dock space.

Port of Cleveland, Ohio, U.S.A.—continued

The construction of 11,000-ft. of new, steel dock has been completed at 18 locations along the river where the channel is being widened and at city-owned property. This bulkhead, if all set up in one length, would make a steel wall 50-ft. high and 2 miles long. Such dock construction has cost approximately $125 per ft. Through its construction there has been provided 2 miles of splendid new dock and it has eliminated an equal length of old and dangerous piling which lined the banks of the river.



One of the powerful dredgers of the Great Lakes Dredge and Dock Co. at work.

New steel and oak timber fenders were constructed to keep the boats from running into the piers of five of the older bridges where reconstruction of the entire bridge was not required. The piers of the Willow St. Bridge, Centre St. Bridge and Scranton Road Bridge were underpinned and protected from scouring and undermining by the construction of steel sheet piling walls.

The combination land and water fire station house on the river at Collision Bend has been moved back some 450-ft. and now fronts on the intersection of two main thoroughfares as well as the river. The grounds about the re-located fire station and including the entire corner of city-owned property have been landscaped. This will give the valley a river-side park from which to watch the passing ships. A "slip" for fire tugs was constructed adjacent to the re-located fire station to replace the dock facilities at the old station location.

Land Purchase.

Some 37 parcels of land, or rights in such parcels, were purchased for widening the channel in addition to the land which the City already owned for river widening purposes. Approximately 963,000 sq. ft. of land is included in the present widening of the river, of which 35 per cent was previously owned by the City of Cleveland. The cost of the land purchased for river widening purposes amounted to $802,614.

The City, in order to be fair to all property owners, engaged 3 expert real estate appraisers to study each parcel and its right to be acquired and to place upon it a fair market value; fair to the owner and fair to the City. In only two cases was it necessary to resort to appropriation proceedings in the Common Pleas Court. After the City had acquired the rights in the several parcels of land, an easement in all of the land used for the river widening was conveyed to the U. S. Government for the purpose of making the newly widened portion of the channel a part of the navigable waters of the U.S., to be thereafter maintained as navigable waters by the Federal Government.

The purchase and removal of the highly obstructive Wheeling and Lake Erie Railway Bridge crossing the river at Wheeling Bend was one of the outstanding achievements. That particular bridge had been a "bottle-neck" on the river. With its removal the largest boats can pass the full 5½ miles up the river, to the steel mills. The removal of this railroad bridge was completed by standing the steel span up vertically, 200-ft. high, and blasting the shore legs of the tower out from under it, thus laying the bridge on its back on the river bank where the steel members were cut apart. The purchase price, including the land required for widening the channnel was $281,016.

Construction Costs.

The construction portion of the improvement in which the Public Works Administration participated consisted of 34 contracts under which $4,100,318.74 was paid to the contractors. The entire improvement was reported by Public Works Administration officials as having been substantially completed in accordance with the authorizing Act of Congress as of June 30, 1940.

Engineering, inspection and testing costs amounted to only 4.6 per cent of the total cost of the improvement. These include all consulting engineering fees; the engineering staff hired by the City; the inspection staff employed by the City; the cost of testing materials by the City's testing laboratory and the cost for such testing of materials in private laboratories as could not be performed by the City.

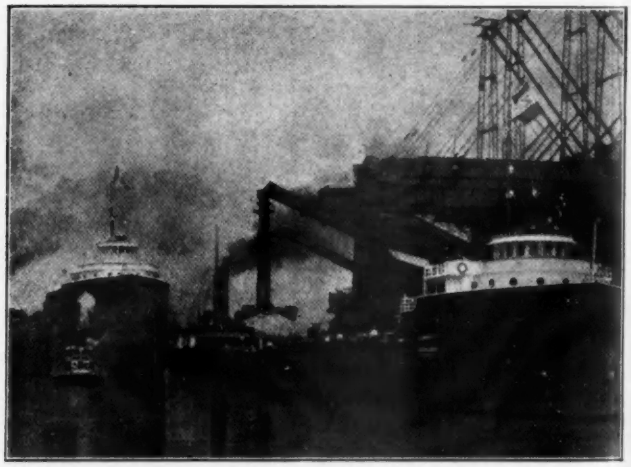
The cost of the supervising, designing, inspecting and testing on the construction of bulkheads, buildings and other structures for which plans were made by the City's own force, amounted to only 3.1 per cent of the construction cost.

Probably the outstanding achievement in the building of the improvement, from the standpoint of the public and taxpayers, is that the total cost of the improvements is more than $250,000 *less* than the estimated cost and funds provided and in addition the City has been able to construct over $311,000 worth of new bulkheads and bridge underpinning work that was not contemplated or expected to be done at the time when the improvement was started in Oct. 1938. This saving has been brought about through the careful planning of the new construction work and economical purchasing of the land required.

Over 18,000 tons of new steel was used in the construction of the river improvement, together with approximately 18,000 cu. yds. of concrete, and over 15,000 gals. of paint.

An ever-growing popular pastime for the people of the community is watching the boats moving along the river. For their convenience and enjoyment, splendid vantage points have been provided incidental to the improving work. The new steel bulkhead across Front St., just inside the river mouth and opposite the old river channel, provides a splendid spot from which to watch the boats go by. Willow trees have been planted there in the hope that before many years a shady spot may be available for the onlookers.

Another river-side, public place has been built within 5 minutes walk of the Public Square, where a new steel bulkhead was constructed across the foot of Superior Ave. Here also it is hoped



Great Lakes Ore Carriers unloading at Cleveland with 4 Brown Hoist Rigs and 2 large Hulitt Ore Unloaders.

that the Willow trees will grow to provide shade for those who, at noon, may enjoy watching the boats go by. Perhaps a "Moses Cleaveland Park" can be established on the bank.

Advantages Derived.

The question is frequently asked as to how long it took a large, loaded ship to travel the 5½ miles up the river channel before the improvement was started. That depended upon the current in

The Offices of the Port of Bristol Authority

The Office Building

The Head Office of the Port of Bristol Authority is situate on the East side of Queen Square. The building, erected in 1885, by Messrs. Wm. Cowlin & Sons, to the design of Mr. W. V. Gough, F.R.I.B.A., is of brick with buff-coloured terra-cotta dressings. The main stairs are stone, lighted by handsome stained glass windows and flanked by moulded and enriched grey coloured terra-cotta balustrades with symbolic figures terminating the newel posts.

in mosaic. The dog grates are worked in wrought iron with brass dogs, the latter carrying brass plaques with the date of erection of the building inscribed thereon. Pediment features surmount the oak panelling around the fireplaces and at the South end this feature accommodates a clock.

At each side of the fireplaces are wrought iron light brackets. Originally three elaborate chandeliers provided the main artificial lighting; these, however, have been removed and simpler fittings with confined shades take their place.

The main feature in the furnishing is the handsome " D " ended oak table with blue hide inset top.

The original principal chair in oak, upholstered in hide and bearing the City's Coat of Arms, is an interesting feature; so also is the original carpet, both adding dignity to the room.

The Board Room

The Board Room, shown in the photograph kindly supplied by the Authority, is entered from the main landing on the first floor. This is a happily proportioned room, 37-ft. long, 21-ft. 6-in. wide and 14-ft. 6-in. high, panelled with selected oak to a height of 8-ft.

Above the panelling is a gilt-covered and enriched wall covering, surmounted by a delicately-moulded plaster frieze. The ceiling is divided by carved oak beams, bearing on carved oak brackets, into five bays, the whole surrounded by an oak cornice. The bays are ceiled in pine and divided by oak ribs into a pleasing geometrical design. The room is naturally lighted by three double and two single sash windows in oak. Over these windows are stained glass panels, the two middle ones appropriately depicting Sebastian Cabot and J. Whitson. The windows give access to balconies, from which important proclamations have been made.

The floor is in limed oak boards laid in herring-bone pattern. At each end is a fireplace with cheeks formed in antique tiling, the blue colour of the latter blending harmoniously with the oak panelling. Special inset tiles of a maritime nature are interesting features. The surrounds and kerbs are in marble and the hearths

Members in Session

The photograph shows the following members in session with officials at one of their recent meetings. The Authority is constituted by a special committee of the Bristol City Council.

Presiding at the head of the long central table is the chairman, Alderman A. W. S. Burgess, J.P. Seated on his right hand is the Secretary and Collector of Dues, Mr. Alfred J. Lloyd, who has recently retired on superannuation.

In order on the right-hand side of the table commencing from the top, are Alderman Frank Moore, J.P.; Alderman C. Hartly Hodder, Councillor P. Raymond, Councillor Frank Phippen and Councillor H. R. Griffiths, O.B.E. On the left-hand side of the table also commencing from the top, are the Town Clerk of Bristol (Mr. Josiah Green); Alderman G. Shallard, J.P.; Alderman James Owen, J.P.; Councillor F. A. Parish, C.B.E.; and Alderman R. F. Lyne.

On the extreme left are a Committee Clerk (in the corner); Mr. R. H. Jones, O.B.E. (General Manager); Mr. F. D. Arney (Assistant General Manager); and Mr. W. P. Wordsworth, B.Sc., Assoc.M.Inst.C.E. (Chief Engineer).

Correspondence

To the Editor of "The Dock and Harbour Authority."

Dear Sir,

Tonnage Measurement: The Need for Revision

When Mr. A. Murray Stephen delivered his Presidential Address to the members of the Institution of Engineers and Shipbuilders in Scotland on the 12th of October last, his intention was to focus attention on the much-debated subject of Tonnage Laws. His proposals for the elimination of all the drawbacks associated with the current regulations are bound to create discussion and strong criticism.

While agreeing with Mr. Stephen that the time is overdue for a reconsideration of the methods adopted for measuring ships for register tonnage, I cannot accept his antidote for destroying the canker in a set of worn-out regulations.

For nearly ninety years the principle of internal measurement has been the basis of tonnage measurement of British merchant ships. The British Rules have been accepted and adopted by every maritime nation throughout the world.

It must be understood at the very outset when considering this subject that the original intention of the Government, when they introduced a system for measuring ships for register tonnage, was to identify British merchant ships and obtain particulars for the issue of Certificates of Registry. The system of registration goes back as far as the Navigation Act of 1660. In later years net register tonnage has been used by the Government for the payment of dues in respect of the upkeep of harbours, lighthouses, etc.

It will be seen, therefore, that the Governments are responsible for the measurement of ships for their own requirements, and are not concerned with the payment of harbour, docking, or any other dues charged by the Authorities outside the Government jurisdiction.

The Harbour and Docking Authorities have, as a matter of convenience, adopted the official registered tonnages which appear on the ship's Certificate of Registry, for a basis upon which they charge their dues. It is this fact which has created so much doubt in the minds of the authorities concerned, shipowners and shipbuilders, as to whether the present system of measurement, in the light of modern ship development, provides the fairest basis for "services rendered," a true indication of the earning capacity of a ship, and a just comparison between ship and ship.

The subject has been discussed continually in technical societies for many years, but without tangible result or action taken to approach the Government for a reconsideration of the method of tonnage measurement

The Governments of the maritime nations are not satisfied that there is a general demand for alteration, and with this impression in their minds, sent representatives in 1925 to Geneva as a sub-committee to the main Technical Committee on Maritime Measurement associated with the League of Nations. The final text of the International Regulations for Tonnage Measurement of Ships was issued on the 30th June, 1939, and if it had not been for the intervention of the present war there is little doubt that these regulations would have been adopted by all countries.

Shipowners, Shipbuilders and Docking Authorities were not represented at the Geneva meetings, but they have had plenty of opportunity during the interval of time between 1925 and 1939 to raise their voices in protest against the proposed International Tonnage Regulations. Silence naturally suggests acceptance.

I am convinced, from my observations at meetings called for the purpose of discussion, that the number of technicians who feel confident to boldly grapple with the problem of tonnage is very few. The Tonnage Laws are complicated, like most Government enactments, and little understood; they always have been and always will be; so why bother? This has been the general attitude adopted in the past.

Mr. Stephen has the courage of his own convictions by tackling the problem from the shipbuilder's point of view, and calls attention in his address to the salient features of the present regulations which are having a detrimental effect on the development of modern ship design. I agree with him in his plea for simplification, but not to the extent of adopting a formula which closely approximates to the one in existence more than one hundred years ago, which was responsible for the production of so many unseaworthy ships through juggling with dimensions.

The present system of internal capacity measurement *can* be simplified. The regulations must be amended in respect of the propelling power allowance, so that they do not cripple or hinder the trend of modern engine design.

The whole system of "exempting" spaces for measurement is illogical and absurd, and tends to produce an unseaworthy type of vessel. We must obliterate from our minds the legal decision pronounced in the dark ages in the "Bear" case, which produced the shelter deck steamer. The present Rules and the proposed International Tonnage Rules are, to some extent, in conflict with the International Load Line Rules in respect of exempted spaces, and there is need for adjustment in order to produce the best type of seagoing steamer.

From my own experience in measuring ships for register tonnage, I can, with confidence, state it is quite unnecessary to take the measurements *from the ship* according to the official requirequirements. We do not calculate displacement from offsets obtained at the actual vessel, and the tonnage particulars can be obtained in the same way.

The alternative methods proposed in the past for assessing net register tonnage include a basis fixed on deadweight, or on displacement, or on linear dimensions, or on gross tonnage without any exemptions and deductions. My own personal opinion is that a modified system of internal capacity measurement would provide the most likely basis for international discussion. If the concensus of opinion makes it imperative for the present law to be amended, it must be done *internationally* to become effective, and the present time is certainly not opportune.

The problem is such as to suggest that it is not so simple as multiplying two by two to produce four. If representatives of Shipowners, Shipbuilders, Docking Authorities and Underwriters could meet together in conference, I feel quite sure that a simple method of producing registered tonnages could be devised for presentation to the Government.

Yours faithfully,

ERNEST W. BLOCKSIDGE, M.I.N.A.

London, January, 1943.

To the Editor of "The Dock and Harbour Authority."

Sir,

Ships' Tonnage in relation to Port Dues

Mr. Murray Stephen's address on this subject is very interesting and should form a basis for the adoption of a universal method of assessing the Port dues chargeable on ships for berthage.

A point which might be raised is whether the third factor, i.e. the depth of draught of the ships, need enter the calculation.

From the Dock authorities' point of view the area occupied by the ships might reasonably be the main consideration.

In one instance within the writer's experience where, the service (in the nature of "laying up") was not tied to the statutory schedule, a scale was adopted based on the extreme length by the extreme beam, the rate being so much per 25-ft. or part thereof. Extreme measurements were taken, as, allowing for mooring ropes, the space occupied is usually more than the ship's length.

The rate could be quoted as say 6d. (or the economic rate the Port requires) for each 25-ft. of the overall length multiplied by the extreme beam or some such formula.

Simplification of the method on which ships are measured for the purposes of Port dues is, however, only one side of what would appear to be a needlessly complicated system common to perhaps the large marjority of our Ports.

On the other side there are endless variations in the rates raised by the Dock authorities on ships, depending on what part of the world the ship is going to or coming from—whether foreign or coastwise—whether inwards or outwards and in addition there are, at many ports, separate charges for Harbour lights, police, anchorage, etc. Is the time not ripe for the introduction of a consolidated rate—and if possible a single one at that?

There is also the question of the period over which the Port due on ships extends—24 days or 28 days in many cases, or it may be a month. There is no uniformity of practice in this respect and there does not seem to be any reason against a standard practice.

Correspondence—continued

From the Dock authorities point of view it might be said that most of these long periods are survivals of the past when the turn-round of ships was much slower than today, having regard to the improvement in Dock equipment.

The writer would suggest for consideration as meeting the requirements of today that the Port due on ships should cover 10 days with an addition of 10% for each day in port thereafter.

Yours faithfully,

43, Moray Place, G. MATHESON.
Glasgow, S.1.
29th November, 1943.

To the Editor of "The Dock and Harbour Authority."

Sir,— **Electric Cranes**

I have read with great interest the series of articles by J. Dalziel, M.I.E.E. on "Quayside Cranes and other Cargo Handling Appliances at Ports," and notice the great stress laid on high speed operation of crane hoists.

No doubt your readers will be interested to learn that the Igranic Electric Co. Ltd., have now produced a dynamic lowering hoist controller for D.C. supply and series motor, which will permit lowering of the light hook at speeds up to 200% of normal full speed. This controller will also permit full loads to be lowered at up to 190% speed if required.

By adjusting the resistances, either or both of these speeds may be reduced if found desirable.

Six stable speeds are provided for lowering and the bottom speed with full load on the hook is about 35%, with lower speeds on lighter loads.

To protect the motor and gearing from injurious overloads, slowing down is performed by full graduated dynamic braking which is timed by Igranic ITL (Inductive Time Limit) control.

Yours faithfully,

IGRANIC ELECTRIC CO. LTD.
Bedford. J. RUSSELL TAYLOR.
29th November, 1943. Chief Engineer.

To the Editor of "The Dock and Harbour Authority."

Dear Sir,

Electric v. Hydraulic Quay Cranes.

In reply to Mr. Dalziel's letter of the 18th October and with particular reference to his comments regarding acceleration, I give below the results of actual tests made upon a 3-ton electric crane built in 1934 and a 3-ton hydraulic crane of the same date, both having an overload capacity of 25% above the normal working load.

The time required to attain full load speed of 240-ft. per min. with full load of 3-tons was in the case of the hydraulic crane two seconds against seven seconds for the electric crane. A further point noted during the test was that the lowest creeping speed of the hydraulic crane was 13-ft. per min. against 75-ft. per min. for the electric crane.

My comments re electrical breakdowns were based upon the assumption that maintenance is carried out upon a properly rostered basis which is obviously essential and the cranes under comparison are generally of the same date and operating under similar conditions.

I agree that the provision of contractors particularly if designed to give automatic acceleration does reduce controller maintenance, but even under these conditions in view of the admittedly fewer working parts associated with the hydraulic crane I have found in practice these require far less maintenance.

I agree the question of frost does not arise with an electric crane but would submit that humid and polluted atmospheres do adversely affect electrical equipment, and this is proved by the incidence of failures during certain periods of the year. With regard to hydraulic failures due to frost, these can be almost eliminated by correct drainage and heating if necessary.

Where electric cranes are installed the continuance of this type is often a question of expediency rather than selection of type.

Yours faithfully,

C. H. NICHOLSON,
Docks Machinery Engineer
Hull, December 4, 1943. L.N.E.R. Hull.

To the Editor of "The Dock and Harbour Authority."

Dear Sir, **Terminals.**

Regarding your editorial comment in the November issue, I suggest it is in a vain quest to seek for the "precise" signification of technical terms relating to ports, especially if taking into account both British and American usage. The outstanding example is the term "dock," which in English is the enclosed water and in American is what in English would be called the quay or pier, or wharf, or jetty. So a man may fall *off* the American "dock" *into* the English "dock." This anomaly was brought out in your own book on "Port Economics."*

The difficulty of definition confronted me when undertaking some years ago to lecture on "Ports and Docks" to College students. I essayed the following: A "port" is a gateway into or out of a country, where transportation changes from overland to waterborne. A "dock" is a hollow enclosure or receptacle filled with water. A "terminal" seems to have two variants of meaning, at sea and on land respectively.

From the shipping point of view, the terminus or terminal port is the ship's destination, where the voyage ends or terminates, all other places touched at being ports of call.

Viewed from the land, every port is both a terminus and a terminal: a terminus in the sense of being the end of its landward communications, by railway, road or canal, and a terminal in a sense analogous to electrical usage. In the British Standard glossary of electrical terms a "terminal" is defined as "that portion of a circuit or piece of apparatus which is intended for the reception of conductors by means of which it may be connected electrically to another circuit or piece of apparatus."

By analogy with this, a port is "that portion of" a landward "circuit" or system of communication, which is "intended for the reception" of ships, so that by means of shipping lines, as "conductors," it may be connected to another system of communication on the further shore. It is the place of transition where a change is made from land to sea transport so that, by the latter, communication may be established beween one landward system and another.

It is the latter meaning that is most nearly akin to that implied in Colonel Jones' article on a "deep water terminal" in America, published in the November issue, with this difference, that the terminal there is not a port, but one berth, or group of berths, as a constituent element in a port of many berths. To pursue the electrical analogy, it is a point, among several, where a ship can "plug in." The shipping line is the multicore conductor whereby two countries are connected and the ports—or the berths in ports—are the terminals or points of connection.

But such terms are fluid and not precise, living and not rigidly stereotyped.

Yours faithfully,

A. T. BEST.
Westminster, December 8, 1943. M.Inst.C.E.

[We would remind our correspondent that a "dock" is not invariably "filled with water": a dry, or graving, dock fulfils its essential function only when emptied of water, while a floating dock is withdrawn from the water in order to achieve its purpose—*Editor.*]

Dunbar Harbour Repairs.

Dunbar Town Council has agreed to carry out repair works to the harbour there, despite the fact that an application to the Secretary of State for financial aid has been refused. The work will cost several hundred pounds. There is a possibility that assistance may be given at a later date for dredging operations, assuming the completion of the repairs to the actual harbour works.

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*"Port Economics," by Brysson Cunningham, D.Sc., Chap. 2.

The Port of London and its Overseas Trade

Address on Imports, delivered by the Rt. Hon. Thomas Wiles, P.C. (Chairman, Port of London Authority)*

Past History.

In London's long story as a Market Place crises have arisen from time to time and meetings of the kind we are called to attend to-day have been held to organise a strong and concerted front composed of the leaders of all branches of its commerce. Soon after William the Conqueror arrived in Britain he parleyed with the City Fathers and gave London its first Charter, which preserved the trading institutions by then already established. When the terms of Magna Charta were being drawn up no doubt another meeting was held for London's port and market rights were again preserved and inscribed in that historic document. Coming to much more recent times London merchants conducted a positive campaign on a purely domestic issue when, at the end of the 17th century, trade was threatened by evils resulting from inadequate port accommodation. The leader of the agitation for reform was one William Vaughan who, besides being a public-spirited city merchant imbued with energy and foresight, was a pioneer advocate for the construction of London's dock systems, which have since been so important in the maintenance of London's trade. He not only called meetings but wrote and distributed " Tracts " —propaganda pamphlets we should call them now. A few sentences from one of them seem to me particularly appropriate for to-day, when it is not only seemly but our duty to think and plan post-war policy. Here is an extract from his parable:—

The Rt. Hon. THOMAS WILES, P.C.

"At the present, our Commerce is like an invalid labouring under a long confinement and a complication of disorders, standing in need of the best advice, without the faculty understanding the nature of her case. The State recommends bleeding, the City confinement, and the Merchants restoratives. The constitution of the patient is naturally strong and vigorous, but she sickens with confinement; she wants room, freedom, and air, to be derobed of her flannels, and to have the free command of her limbs. Consult nature, and let her take her course; invite commerce to our ports by a freedom, dispatch, and security within them; the times are ripening to great changes in all our commercial systems; and it depends upon ourselves how far we shall grasp and secure the blessings that may await us. Commerce is a fickle mistress, but may be made as a fruitful vine; she must be courted by accommodation, convenience, and dispatch."

That is the view, I think, of the condition of commerce as it will be at the end of this war.

Post War Plans.

Innumerable plans for the reconstruction of London are being put forth and many meetings are being called to discuss them. This present meeting I regard as the most important yet held in connection with the post-war problems of London—indeed, of post-war Britain. The plans for a future London visualise a more convenient and beautiful Metropolis at some more or less distant date. But it has not yet been sufficiently emphasised that unless London is re-established in her pre-war eminence as the centre of international trade all schemes for enhancing her beauty will remain disappointing dreams. London is first and foremost a great sea port. If it had not been for the Thames and the facilities the Port of London afforded for the discharging and loading of ships and the distribution of cargoes, London would never have existed. If suddenly through some convulsion the course of the Thames was diverted or its estuary sealed up, London would soon be little more than a mausoleum of great and glorious memories and of planners' blue prints. Throughout the centuries the trade and activities of the Port of London have been the solid basis of all other London businesses and occupations—from shipping, banking, insurance and large industries to the small manufacturer, retail trader and those who practise the various professions. Therefore one cannot speak separately of the port of London and the Market of London—they are one and indivisible. It is not fortuitous that we speak of trade flowing like tide or river; trade like a river will find its own natural channel and we attempt to change the course of either at great peril. During the war the course of trade has not been changed—it has simply been held in a state of suspension. Obviously this has been unavoidable; but the cost of subsidies and administration to the taxpayer have been such that they just could not be supported indefinitely. Not only have the functions of London as a world market been in abeyance, but it was one of the nation's penalties of unpreparedness that it was not possible for a time to deploy adequate naval and air protection for shipping to approach Britain's greatest Port when the enemy ranged his maximum attack against the Port of London. The diversion of traffic from its normal and natural channels of distribution has been costly to the nation in time and money, and wasteful in the use of transport. In the interests of the nation this must be remedied as soon as controls can safely be relaxed, because it is only by the resuscitation of London as a free world market for commodities and services, that the machinery of world trade can be geared to peace-time world production.

It is not adequately realised, I think, in this country, let alone outside it, that our rise to national greatness and prosperity, is due to the enterprise, integrity and good faith of generations of merchants and traders. Moreover, the real or "inside" story of the building up of the British Empire is to be found, not in the annals of military history, but in the records of the London markets. It is true, of course, that sea-power protected commercial activities, but force of arms could never have permanently induced world-wide mutual trading.

London's Pre-War Trade.

As I have already said, the Port and Markets of London are inter-dependent and I would like to give a short outline of the trade of the Port of London before the war as a background to what other speakers may have to say on London's many specialised markets for commodities and services.

I will not attempt in so short a time to show how for 2,000 years the Port of London has been the very mainspring of London's life, but will only recall that it was the falling away of trade because the port facilities were inadequate and ill-organised at the beginning of the present century that the Port of London Authority was brought into existence in 1909. Since then the Authority have carried out great programmes of development and re-equipment with the result that before the outbreak of the war the Port's traffic reached record proportions. Over 62 million net reg. tons of shipping arrived and departed from the Port in the course of a year. Two-thirds of the shipping were engaged in trade with Empire and Foreign Ports. The turn-round of these ships meant the handling of 44 million tons of imports, exports and transhipments. The total value of the Port of London's over-

*At a meeting on 24th November, 1943, at Grosvenor House, Park Lane.

The Port of London and its Overseas Trade—continued

seas trade in 1938 (the last complete pre-war year) was £593 millions, sterling. This represents well over a third—actually 39 per cent.—of the total overseas trade of the United Kingdom.

Lord Leverhulme will have something to say on the export trade, so I will confine myself to a few further remarks on the import business. The total value of the Port's Empire and foreign imports in 1938, was over £400 millions. That amount of business represents the enterprise of thousands of firms from the large importing houses down to the one-man specialist importer of perhaps one or two commodities. The variety of goods dealt with is impressive and comprises something like 4,000 items.

The enormous number of transactions involved in the port's import trade is indicated by the 1,090,000 Custom entries passed in a normal year. One entry may cover several consignments of costly Chinese curios; another half a cargo of tea. But each one of these entries is the climax to the enterprise and labours of some London merchant importer.

Here are the figures for a few of the largest classes of importations:—

Grain, Seed and Flour	2,760,000	tons
Sugar	1,213,000	,,
Tea	486,000,000	lbs.
Provisions	922,000	tons
Fruit and Vegetables	897,000	,,
Wood	2,229,000	,,
Wool	872,000	bales
Metals	881,000	tons
Paper, Millboards and Pulp	1,194,000	,,
Rubber	234,000,000	lbs.
Petroleum	3,598,000	tons
Wines and Spirits	12,313,000	gallons
Tobacco	76,000,000	lbs.

There are many other classes of raw materials and goods which although they are not imported in spectacular quantities are often very valuable and vitally important for processes of manufacture and from the marketing of which considerable profit derives to the country. For many of these London has become virtually the world market, providing a well-organised channel of distribution and performing a service to the world. In this category are ivories, chemicals, carpets, drugs, spices, isinglass, hides and skins, copra, essential oils, shells (Mother of Pearl, tortoiseshell, etc.),ambergris and other materials for perfume making, fibres, indigo, iodine and numberless others.

The handling of all these commodities involves the employment of great skill and knowledge in their preparation before marketing; sampling to establish average qualities and grades, sorting, garbling, cataloguing, reporting upon condition, and so on. All this can only be acquired over years of experience and in a market through which consignments are extensive and regular. Commerce is a profession and those who practice it must first be students and apprentices. Apprenticeship is served better in the docks of London and in merchants' offices or showrooms than anywhere else. London is the University of Commerce!

If the figures I have recited meant to us only so many million bags, bales and boxes we should indeed be lacking in imagination and unworthy of our responsibilities. We know they represent the labours of literally millions of pairs of hands of people of every colour, working under all sorts of climatic conditions, in fields and pastures, deserts and jungles, forests and mines, plantations and prairies. Every ounce has to be packed and transported to ports in all parts of the world before being finally shipped and brought across the seas to London River and the docks. All this effort and organisation reaches its climax in the sale rooms of London's commodity markets. The livelihoods of millions depend upon the smooth working of this machinery. It is the duty and responsibility of London to get this mechanism going again and where necessary to improve it. Thus will London restore confidence and stability to the commerce of the world and help to institute the reign of a prosperous peace.

Benefits to the Community.

What advantages do the multitude of large and small importers of goods through the Port of London confer upon the community in this country? The public obtain the undoubted benefits which dealings undertaken in great markets—in the case of London thronged by buyers and sellers of many countries—invariably ensure. In this highly competitive market the importer must employ all his knowledge and enterprise and skill in the purchase, packing and shipment of his wares to be able to sell to advantage. In an open market his wares must be equal or better than his competitor's goods. The consumer reaps the benefit of lower prices than he would otherwise have to pay and enjoys a general high standard of quality. At the same time prices must be fair to the producer or he will seek to dispose of his wares elsewhere and the market would languish and cease to exist.

Then there are the small specialist men and the roving representatives of the larger merchant houses, who scour the earth for rare commodities and those in short supply, and whose incentive is the knowledge of certain disposal and distribution through such an international market as London.

It is being said that other centres in Britain should share to a greater extent in some of London's commercial activities and that they will not otherwise prosper. The truth is the exact opposite. It is like saying that if the father of a family is successful and prosperous the chances for the members of his family will be restricted and their lot impecunious. The future prosperity of Britain and the Empire is linked with the prosperity of the international trade of London as surely as it has been in the past. If London and its port should not maintain pre-eminence in world trade no amount of good-will and planning will solve permanently the problems of employment elsewhere in this country.

With long personal and intimate experience of London trade and business extending over more than half a century, I am convinced that under peace-time conditions the public have everything to gain by insisting upon the individual importer being allowed to function again in those businesses which have been his life-long study. Only so will the huge national subsidies be abolished and the burden of taxation relieved. War-time control of some essential imported commodities may be necessary for some time after the end of the war, until the natural laws of supply and demand can once again operate. But in my opinion, the restoration to freedom of experienced importers of the vast majority of other goods as early as possible would release enterprise and business acumen, so long necessarily in chains, as no other measures can, and would ensure the quickest turn over to normal industry and commerce throughout the width and breadth of the land. In this healing process of the wounds of war London port and the London Markets have an all-important function to perform. Propaganda is as essential for the future of London Commerce to-day as a knowledge of Basic English may be useful to-morrow. I would like to see the Trade Associations and all the other responsible institutions get together and take steps to educate the public in this country and abroad on the vital services London has rendered in creating and operating the machinery of world trade and its readiness and ability to continue those functions in the future. The Port Authority may be relied upon to ensure the necessary port facilities and we are not unmindful that air transport may soon be an important factor in international trade.

Londoners should always think of their great City as the "City of Ships" and of London's stake in overseas trade as not only a prime necessity for their own livelihood, but its maintenance a responsibility to as many in the world whose well-being in the future, as in the past, will depend upon the integrity and resourcefulness of the London Market.

Speakers who follow are to deal with the manifold other activities of London which are dependent upon London's overseas trades—shipping, insurance, the various commodity exchanges, banking and so on. In the last resort we are all dependent upon London remaining a great seaport—"the greatest import market and greatest export market in the world."

Mid-Scotland Canal Scheme.

The Glasgow Chamber of Commerce, in supporting the project for a mid-Scotland Ship Canal, are reported to favour a route starting from Grangemouth via Kilsyth to the Clyde. The main channel would be 45-ft. deep and 150-ft. wide. This scheme would involve the construction of only two locks, as compared with several required on the Loch Lomond route.

Notes of the Month

Clyde Navigation Trust.

For the fifth year in succession, Mr. William Cuthbert has been unanimously elected Chairman of the Clyde Navigation Trust. Mr. James Leggat was elected Deputy Chairman.

Clyde Pilotage Authority.

At the annual meeting of the Clyde Pilotage Authority, Mr. William S. Coutts, chairman, presiding, Mr. Barclay Hogarth was re-elected deputy chairman and also re-elected chairman of the Executive Committee.

Obituary.

The deaths are announced of Mr. W. H. Breach, O.B.E., at the age of 83, formerly traffic manager of the Aire and Calder Navigation and on active service, of Capt. Harry Charles Birnie, D.S.O., an Elder Brother of Trinty House and a member of the Southampton Harbour Board.

Aberdeen Harbour Board.

Sir John Irvin, convenor of the Finance Committee of Aberdeen Harbour Board, has been reappointed to that post. This continues an unbroken record of service as finance convenor since 1911 and a continuous service as a member of the Board since 1902.

Appointment of Regional Port Director.

The Minister of War Transport has appointed Mr. R. Hugh Roberts to be Regional Port Director for the South-Western Area (comprising the ports between Fishguard and Weymouth, both inclusive) to exercise, on the Minister's behalf in the extended area, the powers now exercised by him in the Bristol Channel Area and such additional powers as may from time to time be delegated to him. The old Bristol Channel Area has been extended to cover the ports from Fishguard to Weymouth (inclusive) under the new South-Western Area.

New Canteen at Glasgow.

A new canteen for dock workers at Glasgow, with a seating capacity of 300, was opened by Mrs. Ralston Mitchell, wife of the Convenor of the Finance Committee, Clyde Navigation Trust, in late November. The canteen is the largest of the ten such canteens which have been built for war-time catering by the Trust. The Trust reports that increasing use is being made of the canteen facilities which they are offering dockers and that the policy has been well justified.

Durban Dock Development.

In the course of a recent address at the Port of Durban, Mr. F. C. Sturrock, Minister of Transport in the Union of South Africa, announced the intention of the Government to construct a graving dock at Port Elizabeth and one at Cape Town. The object of Mr. Sturrock's visit was to inspect the preliminary works connected with the building of the new 16,000-ton floating dock at Durban and he was shown over the large basin which has been excavated in order that the pre-fabricated parts of the dock may be assembled there. At the Bluff an inspection was also made of the new transporter and dumper, which cost £187,000, for the coaling installation, which was set in operation to demonstrate its capabilities.

Extensions at the Port of Gothenburg.

The extension of the Tingstadshamn at the Port of Gothenburg (Sweden) is to be carried out as soon as possible and the City Council have been asked to provide a sum of 450,000 kr. to cover the cost of the first instalment of the work. The new harbour basin will be 560 metres long, 130 metres wide and 6 metres deep, and will be situated about 150 metres east of the ramp to the Göta River Bridge. The total cost is estimated at 4,650,000kr. The City Council decided as long ago as February 1942, to provide funds for the first stage of the work, but the Swedish Government refused permission for the raising of a loan. The Harbour Board has now raised the matter again, urging that additional facilities are greatly needed.

Clyde Lighthouse Trust.

At the annual meeting in December, of the Clyde Lighthouse Trust, Mr. John C. Graham was re-elected Chairman, and Mr. A. N. Lindsay, of Greenock, vice-chairman.

Proposed Rhone-Rhine Canal.

A radio announcement from Paris has stated that the Marseilles Chamber of Commerce has decided to build a canal connecting the Rhine and the Rhone.

New Dredger for Lagos.

It is announced that a free grant of £130,000 is to be made under the Colonial Development and Welfare Act, in order to enable the Lagos Government to replace a harbour dredger which was recently sunk by enemy action. The dredger will be on new and improved lines and will cost in the neighbourhood of £500,000.

Volunteer Labour at Hull Docks.

For emergency services a body of men belonging to the Police Force at Hull have volunteered to work at the docks in times of stress. The men will do the work in their own time after completing their normal police duties and on their free days.

Tyne Pilotage Board.

Alderman Thomas Sykes of South Shields, has been elected Chairman of the Tyne Pilotage Board for the next three years. He has been a member of the Authority for a quarter of a century and has previously been Chairman.

Chairmanship of Dredging Company.

The Right Hon. Lord Southborough has retired from the Chairmanship of the Board of the Tilbury Contracting and Dredging Co. Ltd., who have been contractors for dredging operations at the Port of London for about half a century. He is succeeded by Lt.-Col. Sir John R. Chancellor, G.C.M.G.

Development of Australian Dock Accommodation.

In his recent Election Address, the Prime Minister of Australia, Mr. Curtin stated that concurrently with military operations, dock facilities had been increased at the ports of Sydney, Brisbane, Cairns, Moresby and Milne Bay. Improvements had also been made to the harbours at Fremantle and Hogan Sound. The volume of cargo handled at Australian ports during the first half of 1943 was about double that in the latter half of 1942.

Durham Coast Erosion.

A Conference has recently been held at Sunderland, attended by local authorities and representatives of dock and harbour undertakings in connection with the problem of coast erosion, which is very much in evidence on the Durham coast. The average erosion, along this Coast was stated to be 2-ft. per year; in some places it is as much as 15-ft. A resolution was adopted urging the Government after the war to start schemes for preventing further inroad of the sea on the county.

Death of Admiralty Chief Engineer.

The death has taken place at the age of 63, of Mr. Cyril George Stileman, M. Inst. C. E., a deputy civil engineer-in-chief to the Admiralty and lately a partner in the firm of Sir Alexander Gibb and Partners, MM. Inst. C. E. Mr. Stileman was the son of the chief engineer of the Furness Railway, under whom he received his technical training. In 1901, he was appointed assistant engineer to the Bombay Port Trust, and later, became deputy chief engineer, having however, to relinquish the post in 1924 on account of a breakdown in health. In 1925, he joined the staff of Sir Alexander Gibb and Partners, acting as senior civil engineer in charge of their Bombay office. He returned to England in 1929 and was engaged at the head office of the firm principally in connection with work in India, including projects relating to docks and harbours. In 1940, by arrangement with the same firm, he was seconded to take up the position of deputy civil engineer-in-chief to the Admiralty.

Harbour and River Works in the United States

*United States Military Engineers in Peace-time Civil Work**

By Major-General JOHN C. H. LEE, U.S. Army.

Mr. President and Brother Engineers,

It has long been the privilege of the Corps of Engineers in America to work in close co-operation with your sister Institution in the United States, the American Society of Civil Engineers. Since the arrival of the United States Forces in Great Britain it has been a source of great satisfaction to us to receive many evidences of friendship and co-operation from The Institution of Civil Engineers. We have long had a very high regard for The Institution and its many achievements. It has been the pioneer, and the world has profited from its work.

I have been asked to describe to you the civil works functions of the Corps of Engineers, United States Army. It is a pleasure to me to discuss this phase of the responsibilities of the Corps of Engineers, because it has been my fortune to spend a number of years on this, to the United States important, and to me very interesting, work. It may seem strange to you that army engineers are engaged in the construction of projects of a civil nature, but the historical background of this policy, which which has been in effect for more than one hundred years, was at first a matter of necessity, and later a matter of choice. This war emergency, and previous emergencies, have seemed to prove the wisdom of the arrangement, as I shall endeavour to point out later in my remarks.

Major-General JOHN C. H. LEE.

Corps of Engineers and Harbour Improvements

I do not want to create an impression that the Corps of Engineers is the only agency engaged in constructing public works financed by the national government. As a matter of fact, in our country such activities of the Federal Government are distributed among a number of governmental departments and agencies, but the improvement of harbours and navigable waterways of the United States has been entrusted to the Corps of Engineers by deliberate Congressional action. Congress has always reserved to itself the authorization of improvements on our navigable waterways under the powers delegated to it by the United States Constitution, and the execution of the work is by law a responsibility of the Chief of Engineers under the immediate direction of the Secretary of War rather than through the direct command channels of the War Department.

A moment ago I said that the Corps of Engineers was selected a century ago as a matter of necessity for this assignment. When our country was very young, and before the founding or expansion of colleges and universities for the purpose of training civilian engineers, the army engineer was almost the only source of engineering talent. There was much survey and reconnaissance work to be done. From the ports on the coast, the routes by natural waterways were the primary means of access to the interior and both ports and waterways had to be improved or developed. As a consequence, officers of the Corps of Engineers were assigned these duties, and the character of their work resulted in confidence, on the part of the national government, in their ability. For a number of years the planning and construction of many roads and railroads and some major public buildings was also performed by officers selected from the Corps of Engineers. In time it became necessary to supplement the services of the small number of officers from the Army engineers by civilian assistants, both professional and clerical, until an organization developed which was called tne Engineer Department. It should be noted that this organization was composed of officers and civilians, and was not a military force. The officers were re-detailed from time to time, to resume their military assignment with troops, but the civilian personnel continued on. I would emphasize the important place of the civilian engineer in our Engineer Department, because much of the success of our civil works programme over the years, and in the present emergency, is due to his professional skill, his devotion to duty, his pride in the organization, and his loyalty to the traditions of the Corps of Engineers.

From a meagre beginning, when a few officers without much assistance were engaged on undertakings sponsored originally by the Federal Government, the Engineer Department has developed into a nation-wide organization, which now consists of eleven Divisions covering the entire continental United States, and sub-divided into approximately fifty Districts. Since the beginning of the present war, and the assumption of military construction as a new responsibility, which I shall mention later, Divisions and Districts have been created outside the United States where the work is not in a theatre of operations. In the European Theatre, for instance, we have no divisions or Districts, as it is only a Military Command. Engineer Districts are the basic units charged with the field planning and the execution of projects. Owing to the fact that navigation and flood control projects were the normal assignments before the present emergency, the District boundaries were generally chosen to embrace complete water-sheds, and yet adjusted in size so that large overhead expense could be avoided and the maximum efficiency obtained. Districts are grouped into Divisions, the boundaries of which cover large geographical areas. Our Districts and Divisions function as closely knit but self-contained units, responsible successively to a single administrative authority and operating under the traditional policy of the Corps of Engineers, which provides for delegating adequate authority to its executive personnel. Standard procedures prescribed by the Chief of Engineers are employed in handling tenders (we call it "advertising for bids"), awarding contracts, reporting for funds, and the employment of personnel and other administrative matters. Engineering design and specifications are given only general supervision by the Office of the Chief of Engineers, these matters being de-centralized to the greatest possible extent to Division and District Engineers.

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As a technical group, perhaps you will be interested in the types of construction operations in which we were engaged before this war emergency, and which we are carrying on even now where the projects are vital to the war effort.

The public works that have been and are being constructed by the Engineer Department may, for convenience, be grouped in two categories—namely, navigation improvements and works for flood-control. In many cases, however, the adopted project provides for the improvements of a stream for both navigation and flood control as well as other allied purposes.

Harbours of the United States.

When navigation is mentioned, one's thoughts usually turn to the ample harbours which indent the ocean and gulf coasts and lake shores of the United States. These harbours are the gateways through which moves the tide of our foreign and inter-coastal shipping. Most of our major harbours on the east coast have been in use since Colonial times, when their natural advantages attracted the shipping of that day and stimulated the growth of cities on their shores. To-day these harbours, together with more recently developed harbours on the Gulf of Mexico and the Pacific Coast, have been improved to provide channels and anchorage-areas ranging from 30-ft. to 40-ft. in depth. In case of New York Harbour, work is under way which will provide depths of from 45-ft.

*Excerpts from Address delivered to Institution of Civil Engineers, 11th May, 1943, and reproduced from the Journal of the Institution.

Harbour and River Works in the United States—continued

to 48-ft., stimulated primarily by the British shipping programme of majestic "Queens" which are proving so useful in this war emergency.

Next in importance are the harbours of the Great Lakes, which handle vast quantities of basic commodities such as iron ore, grain, limestone and coal. The Great Lakes connecting channels, Canadian and United States, which carry a steady parade of shipping, are the busiest waterways in the world. These harbours and channels have been improved so that they can be used by the most modern type of lake carriers, which draw about 21-ft. when fully loaded.

In addition to these larger harbours, there are hundreds of small harbours on our sea-coasts, on our tidal waters, and on our freshwater lakes. Such harbours, with their improved channels and anchorages ranging from 6-ft. to 12-ft. in depth, support useful fishing industries, provide transportation of bulk commodities, and serve as the focal points for recreational areas.

A group of British people need hardly be reminded that a seaport is the link between land and sea, connecting the inland ways of rail, highway, and river with the ocean lanes of maritime commerce; and, as you will also realize, the planning and execution of improvements that will facilitate this change from sea to land and from land to sea often involve complex problems. For us who are charged with such harbour work and planning, it is a question of utilizing hydrographic and topographic conditions to provide entrance channels that are safe and usable in all weathers, interior channels which will permit the movement of crowded shipping to terminals without congestion, and anchorage-areas which are protected from storms. All this involves careful consideration of existing structures and utilities, such as railroad terminals, bridges, sewers, pipelines and cable crossings, the location of piers and warehouses, and the planning for future growth and expansion.

Harbour Improvement Methods.

The improvement of our harbours has been accomplished primarily by dredging and by the construction of breakwaters. Well suited to such work of excavation are the pipeline dredges which pump out material to make new land in spoil-disposal areas; dipper dredges and drill boats for the removal of rock ledges and shoals (we do not use the ladder dredge which we find mostly in Great Britain); and seagoing hopper dredges which are able to carry large quantities of material within their hull for disposal out at sea. The development of this last-named type of dredge in the United States has been accomplished mainly by the Engineer Department. Dredging, or wet excavation, has been the customary solution, but dry excavation has been used also when found more economical. In the Detroit River, which connects Lake Huron with Lake Erie, a large part of the 22-ft. channel work was done "in the dry," behind earth and rock cofferdams.

The construction of protective jetties and breakwaters has been a major item of harbour improvement in a large number of cases, particularly on the Pacific Coast and on the Great Lakes, where naturally protected harbours are rare. Types of breakwaters include rubble mounds faced with heavy stone, stone-filled timber cribs with concrete caps, all-concrete structures, and breakwaters utilizing steel or timber sheet-piling. Such massive structures are, I believe, similar in many respects to those built in Great Britain, and are designed to receive the impact of storm-driven waves and to withstand the grinding action of ice floes.

Canals and Inland Waterways.

Closely allied with harbour works are the deep-draught canals for ocean shipping, such as the Cape Cod and the Chesapeake-Delaware canals, and the intercoastal waterways for vessels of lighter draught. These waterways provide shorter protected routes between harbours and natural bays. As such canals usually cut across established rail and highway routes, the provision of bridges with horizontal and vertical clearances to ensure an unobstructed waterway for shipping has been an important feature of construction.

An outstanding navigation development in the United States has been the improvement of the inland waterways. These streams, which initially provided somewhat hazardous pathways for the pioneers who developed our country, have been gradually improved to carry the bulk cargoes of an industrial civilization. In the Mississippi river basin alone there are now more than 11,000 miles of authorized navigation projects under the jurisdiction of the Engineer Department. Large parts of these are only now being completed at depths suited to modern demands.

Of course, invaluable experience with navigable streams of the Old World was available to the Army Engineers of a century ago, when they first began work on American rivers, and European methods were generally given careful study. The methods applicable to the waterways of Europe, however, were not always suited to the untamed rivers in America, and the practice of pioneering in navigation work was necessary from the beginning. Our first river improvements consisted of removing snags—old tree trunks that had floated down and had sunk and become embedded in the river, and which punched through the bottoms of steam-boats—which could be accomplished with limited funds and equipment. At present, our river improvement work falls into two general classes—open channel regulation and canalization.

Open channel regulation has been found best suited to rivers with alluvial characteristics, such as the Lower Mississippi and the Lower Missouri. This method of river improvement can be defined as the continuous, progressive control of a river—contracting it where necessary, giving it proper direction, and securely confining it in place. The design of such an improvement is complicated by the fact that, whilst the whole valley is the natural domain of a wild river, the designer must consider and conserve the development by man that has taken place in the valley. Although the river iself, by its scouring and cutting action when properly directed, becomes the main agent of constructive open channel improvement, this usually involves the dredging of channels through bars to connect the deeper pools of the natural river, and to achieve the improvement of its alignment and hydraulic section. Training dikes of piling or timber cribs must be constructed at points where the river meanders through several shallow channels, in order to direct the flow through a single channel. And, since alluvial rivers are prone to destroy their banks and change their courses, the protection and stabilization of the banks are essential in certain places. Such protection is accomplished by covering banks subject to attack by the current with heavy mattresses of stone, concrete, willow, timber, or asphalte.

The other method of improving a river for navigation (frequently used in Europe, I believe) is canalization and the provision of navigable depths by the construction of locks and dams. By such structures, the natural river course is converted into a series of slack-water pools. Such method of improvement has been used on the upper Mississippi river and on the Ohio river and its tributaries—streams which are characterized by relatively narrow valleys, well-defined banks, and occasional rapids. The first developments of this type constructed by the Army Engineers and by private enterprise on American rivers were small masonry locks, with hand-operated wooden-gates (actually some of these locks were of timber construction), which either by-passed rapids or were constructed in conjunction with rock-filled timber crib dams. From these rather primitive structures we have progressed to standard concrete locks 600-ft. long between gates and 110-ft. wide, with steel gates electrically operated. Navigation dams now in use include the movable wicket-type structures of the lower Ohio river, which permit open river navigation during high water; and the concrete-fixed dams which have been built on the Upper Mississippi, the Upper Ohio, and the Kanawha, a tributary of the Ohio. The latter have wide spillway sections with steel Tainter or rolling-drum gates to control pool-levels and to permit the passage of ice and flood flows.

Planning a canalization programme for a large river requires a thorough knowledge of the stream. The pool-levels, channel-depths, and types of structures that will best serve the needs of prospective commerce must be determined, and the plan must be such that it will fit in with the municipal and industrial developments and with improvement of the river for flood-control and various other purposes.

The improvement of our coastal and inland waterways has proceeded slowly in keeping with the country's need and our means, but the Department has had as an objective a long-range interconnecting development, and to-day we find our nation the

Harbours and River Works in the United States—continued

possessor of an extensive water transport system actually in operation, not yet complete, but sufficiently advanced to ensure the future prosperity and the security of our people. In times of war those projects pay for themselves many times over.

Flood Control Works.

The Engineer Department began planning and constructing flood-control works more than fifty years ago, when the first "levees" were built on the lower Mississippi with Federal funds. The science or art of flood-control, however, is not new, and many, or perhaps all, of the methods in use to-day may have been developed and used in ancient times; but they have been applied rather extensively and on the whole successfully in the United States during the past half-century.

In executing the flood-control projects which have been authorized by Congress, the Engineer Department must deal with floods which range from the slowly-rising, wide-spreading overflow of the Mississippi to the torrential, debris-laden waters which sweep down the barren slopes of our western mountains. Obviously there is no simple panacea for the control of such diverse forces. This control is usually complicated by the fact that man invites destruction by building his homes, cities, and communications in the valleys which are the natural paths of the flood waters. Thus each river presents an individual problem, to the solution of which the Engineer Department applies the methods of control which careful study indicates as the best and most economical.

The flood-control plans which are being executed by the Engineer Department are sufficiently comprehensive in scope and design to develop effectively the water resources of the river basin. They include reservoirs for flood-control, or for multiple purposes, whose effects in controlling floods and conserving water will benefit wide areas. They also include levees, floodwalls, channel improvements, and floodways or diversion channels, which are generally constructed to protect some particular locality.

Levees, as now constructed by the Engineer Department, differ widely from the small earth embankments originally built on the Mississippi and other rivers. The 2,000 miles of levees which now form the main line of defence against Mississippi river floods contain 1,000 million cubic yards of material. These levees are, in effect, low artificial ridges, which are built like earthen dams. They are as much as 40-ft. high in some localities, and have top widths of 10 or 12-ft., whilst they may be as much as 300-ft. wide at the base. These cross-sections vary with the material available for construction, which is carefully deposited by the largest earth-moving equipment. Draglines with long booms and buckets of large capacity have been used on levee construction with considerable success, whilst tower excavating-machines, supplemented by tractors and dump wagons, are also used extensively. In fact, the American advances which have been made in earth-moving equipment, together with our increased knowledge of the use of earth as a material of construction, are largely responsible for the present standard of levee and dam construction, and vice versa.

The construction of adequate earth levees often requires a wide right-of-way, and in cities where land is valuable floodwalls are often more economical. Reinforced-concrete walls with steel sheet-piling cut.off features have proved a satisfactory design. Floodwalls are being used extensively for the protection of cities and towns along the Ohio and the Connecticut rivers where industrial developments crowd to the river banks.

There are numerous incidental design and construction problems connected with levees and flood walls. For example, interior drainage must be cared for; entrances for streets, railroads, and highways must be provided; and on alluvial rivers, banks must be protected to prevent bank caving that would undermine and destroy the protective works.

Diversion channels and diversion floodways are used to provide auxiliary outlets for flood waters in excess of the carrying capacities of the natural channels. In projects now under construction, diversions generally take the form of excavated earthen channels; concrete storm sewers and conduits; or overbank floodways with guide levees where flood waters are permitted to escape over lowlands normally subject to overflow. Such channels and floodways frequently involve the raising of railroads and highways so that transportation will not be interrupted during flood periods.

The improvement of natural channels to increase their capacity is a useful flood-control method, but must be handled with care. In numerous cases ill-advised local efforts at clearing the upper reaches of rivers have aggravated flood conditions on the lands below. For some flood problems, however, channel improvement is the best solution; and the actual work may be quite varied. For example, on the Conemaugh river at and below Johnstown, Pennsylvania, (the place of the famous flood many years ago), the Engineer Department is re-aligning the river to provide a more efficient flood channel and is paving the banks with heavy monolithic concrete. On the Big Black river of Mississippi, channel improvements to reduce flood heights on farm lands consist of removing accumulated drift and over-hanging trees, channel excavation, and dredged cut-offs across sharp bends.

Flood-control by means of reservoirs is, of course, nothing new, but it is a subject which causes much confusion to the layman. Briefly, pure flood-control reservoirs are artificial basins, kept empty except during the flood periods, when they hold back flood waters so as to reduce flood heights in the rivers below. The effect of reservoirs in reducing flood heights is, of course, most valuable in the river valley immediately below the dam, and the benefits become progressively smaller as the distances from the reservoirs increase.

In the construction of reservoirs we build dams of earth or of the various types of concrete, depending on such factors as foundation conditions and available materials. Reservoir control works may be automatic, where culverts without gates are provided to carry the normal stream-flow, permitting the reservoir to fill when that flow is exceeded; or of a type permitting control at will. In either case, emergency spillways are provided to prevent dam failure and other damage in case of excess flows. A special form of flood-control reservoir is the debris basin which is constructed to intercept the debris-laden flood waters discharged by mountain torrents. The project for the protection of Los Angeles, California, includes a number of these basins.

It has been said that the use of a reservoir for flood-control is generally antagonistic to its use for other purposes, as a flood-control reservoir is normally kept empty and ready to store flood waters, whilst a reservoir for power development or water-supply is maintained as full as possible. This is generally true, but there are numerous cases in America where the planned developments warrant, and the physical conditions permit, the building of multiple-use reservoirs large enough to store destructive flood waters, and yet at the same time provide a combination of water storage for navigation, power development, irrigation, municipal water-supply, pollution abatement, and recreation. Often these additional values of a reservoir site are so great that a multiple-use reservoir becomes the most desirable and the most economical project (provided the money is available!). In preparing its flood control plans, the Engineer Department makes every effort to use and conserve water resources to the best interests of the public. As a result, we have recommended and constructed many multiple-use projects. The larger reservoirs now under construction generally provide recreational pools and facilities for future power development in addition to their primary flood-control functions.

The settlement and development of the greater part of the United States cover a relatively brief period of time, and the records of stage and discharge for most of our rivers cover an even shorter period. Therefore, all engineers who have had occasion to design and construct works dealing with water have been confronted with the scarcity of stream-flow records, and have had difficulty in computing maximum flood flows. Consequently, in the past, engineers have had to do their best with the data at hand and to use large factors of safety to guard against failure of structures. When the Engineer Department began the nation-wide flood-control work, it was realized that many reservoirs would be located on streams where adequate flood records were not available, and that some rational method of securing hydrological data for design purposes would have to be developed. Co-operative storm studies which are being carried out by the United States Weather Bureau and the Engineer Department fill this need.

Briefly, these storm studies are an attempt to analyse rainfall records and any stream-flow data that are available, in the light of weather conditions which may affect the river basin in question.

Tyne Improvement Commission

Report of Finance Committee

In presenting the report of the Finance Committee at a recent meeting of the Tyne Improvement Commission, Mr. W. A. Souter, chairman of the committee, said that capital and revenue expenditure for 1944 had been passed by the various standing committees and the Finance Committee had approved the aggregate amount. He thought the Commissioners would agree that capital and revenue must retain their relative positions. Should events during the ensuing months be such as to depreciate further their revenue, then, as chairman of the Committee, he might feel it his duty to ask for further pruning of the 1944 estimates, but he hoped that that would not be necessary. An important item was the terms for loans. It would be seen that the Committee had decided that all mortgages maturing in January next be paid off. The total amount of mortgages maturing during 1944 was not large; indeed, the amounts falling due next year were among the least they had had. As they must redeem their borrowings within the prescribed time in order to comply with their sinking fund obligations, he felt sure they would agree that what was proposed was a prudent step. He thought that the decision was a very strong point in favour of the Commissioners' financial position and would give their lenders that sense of security so necessary to the maintenance of their high financial standing. The Committee's report was formerly approved.

Sir Frank Simpson, moving the report of the River Works Committee, referred to the question of dredging over certain parts of the upper reaches of the river. In view of the volume of traffic and the reports of the Chief Engineer and the Harbour Master it had been decided that dredging could be postponed for 12 months, unless circumstances changed. The estimates of expenditure had been reduced, therefore, by the cost this work would have entailed. The report was adopted.

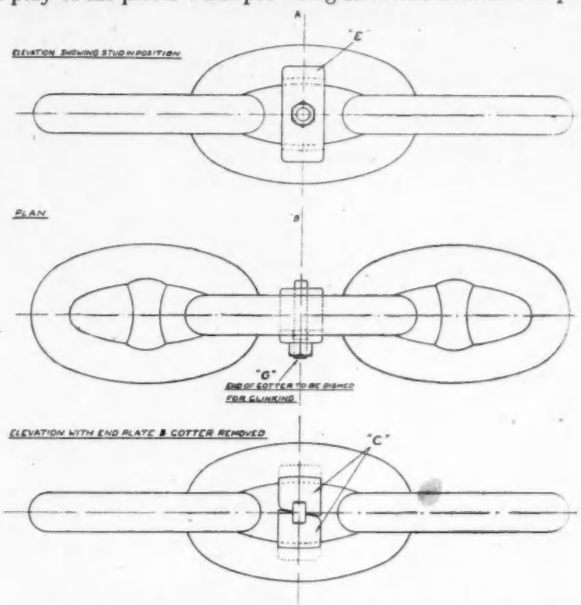
Mr. B. Eliot Common, the Regional Port Director, referred in complimentary terms to the valuable work which Sir Arthur Sutherland, chairman of the Commissioners and of the Port Emergency Committee, and Mr. J. K. McKendrick, Secretary of the Committee, and Mr. N. M. Hood. its chief executive officer, as well as officials and staff of the Commission, were performing.

Replacement of Missing Studs in Heavy Ships' Mooring Chains

In conjunction with one of their foremen, Mr. William J. Muir, the Tyne Improvement Commission have provisionally protected an invention relating to stud-link chains and particularly to those used under water, for example, for buoy moorings in a tidal river where there is a continuous movement of the buoy. This movement in time results in a slackening of the studs of the links of the lower portion of the buoy chain and occasionally in the studs falling out; the object of the present invention is to provide a stud which, by a diver under water, can be inserted to a link from which a stud has fallen out, without disturbing the mooring or detaching the buoy chain.

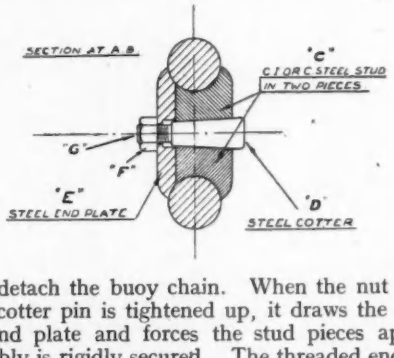
As shown in the accompanying diagrams the stud is in two complementary portions which can be introduced into a chain link to engage the central portions of its sides and forced into rigid contact with said sides, thereby securing the two-part stud immovably in position so that it affords the necessary support to the link.

The complementary portions of the stud comprise two cast iron or steel pieces each of which is radiussed and grooved at one end to suit the profile of the central portion of the sides of the link for which the stud is intended, the walls of said grooves being higher on one side than on the other. The ends of said pieces opposite to said grooves come together when the two pieces are inserted in the link, their meeting faces being slightly bevelled in the lengthwise direction of the link to facilitate the insertion of the pieces thereinto. Transversely said faces are provided with central grooves which combine to receive a tapered cotter pin of rectangular section provided with a threaded extension at its smaller end. An end plate of the same width as the stud pieces is applied to said threaded extension, said plate being recessed on its inner side to receive the protruding end of the cotter pin. The threaded extension projects beyond the end plate and receives a nut which secures the end plate in position, the latter preventing side play of the pieces while providing sufficient clearance to permit



the drawing-in of the cotter pin. The end plate bridges between the sides of the link and completes the walls on the lower sides of the grooves in the stud pieces.

When it is necessary to replace a stud in a buoy chain, it will be found that the assembly of the two-part stud above described is sufficiently simple that it can readily be accomplished by a diver working under water without it being necessary to disturb the



mooring or detach the buoy chain. When the nut on the extension of the cotter pin is tightened up, it draws the cotter pin towards the end plate and forces the stud pieces apart until the whole assembly is rigidly secured. The threaded end of the cotter pin is machined to form a shallow disc which can be clenched over the outer end of the nut when the latter has been tightened up, thereby preventing slackening of the nut.

Canteen for dock workers at London.

A further contribution from the Women's Auxiliary Canadian Legion of St. John, New Brunswick, has been made to the Port of London. On the 7th December, Mrs. Vincent Massey, wife of the High Commissioner for Canada, presented to Mr. W. L. Bolton, Vice-Chairman of the Port of London Authority, another mobile canteen for the use of the dock workers at the port. Accepting the canteen with warm and grateful thanks on behalf of the Port Authority, Mr. Bolton remarked that all the canteens sent by Canada to the Port have been given by women's organisations. The women of Canada were an inspiration to the fighting men and an example to those who worked behind the lines in factories or mines, in shipyards or docks.

National Dock Labour Corporation, Ltd.

Report at Annual Meeting

The third annual meeting of the National Dock Labour Corportion, Ltd., was held in London on 17th December when the chairman (Mr. R. T. Garrett) was able to announce a surprising change for the better in the financial position of the undertaking. He stated that the situation in ports began to undergo this change just before the financial accounts for the year were closed and that the improvement had continued over the intervening six months. The result was that not only had the debit balance on the management fund been completely wiped out, so enabling the repayment of an advance of £35,000 made by the Ministry of Labour, but there was a considerable credit balance, as well as in the reserve fund.

After mentioning that payments for attendance money reached a total of £1,132,398, which meant a weekly average of 18s. 3d. per registered man as against an average for the last accounting period of just under 19s. (though the comparison was affected by the increase from 5s. to 6s. per turn in the rate of attendance money in March last, which resulted in an additional charge on the management fund of about £65,000), the chairman continued as follows:—

Although they had not yet concluded their new financial arrangements with the Ministry, the directors felt justified in making a substantial reduction in percentage payments as from January 1st next. The board had accordingly decided that the levy for the reserve fund should be discontinued. Further, the Minister of Labour had approved the recommendation of the directors that the normal percentage payments be reduced as follows: On allocated workers to 12½ per cent.; on weekly workers to 8 per cent., the employers in the latter case to bear the cost of their contributions under State insurance schemes. That meant that the total contributions paid by employers would fall from 25 per cent. to 12½ per cent. in the case of allocated workers, and from 18¾ per cent. to 8 per cent. in the case of weekly workers.

The reduction represented the limit to which they could prudently go. But he must make it clear that, although it was their hope that they would be able to preserve the new rates at least for six months, the Minister's approval was subject to an immediate review of the position should a change in circumstances warrant that course, and, in any event, to a review in six months' time. On the other hand, if present or better conditions prevailed, it was not impossible that, in due course, they might be in a position to make a further small reduction.

Operational Developments

Dealing with the operational side of the work, Mr. Garrett said that the year under review that seen considerable developments. The number of ports in which they now operated had grown from 32 to 59, and they had now 1,160 employers and 35,000 workers registered under the Essential Work (Dock Labour) Order. That labour force was not evenly spread, for there were about 33,000 men in 20 ports, while the remaining 2,000 men were spread over 39 ports—each of which was difficult and costly to administer. At the instance of the Minister of Labour the schemes had been extended to include coal trimmers, fish dock workers and riggers, involving local adaptations of the scheme to meet the new conditions.

Surveying the year's work, the chairman said that the Corporation's first task was to man the ships with suitable and efficient labour which, with employment at its present level, meant that three-and-a-half million separate engagements per annum were being made at the different call places. They had to work within a framework of very varied industrial practices which differed from port to port. One such practice was the continuity rule. In ports where the continuity rule was in operation the men went direct each day to their place of work until the ship was finished, thus saving valuable time; where there was no continuity rule fresh engagements had to be made daily, or twice daily for the same job as long as it continued.

It was interesting to record that at four of the major ports—Swansea, Cardiff, Newport and Southampton—the whole of the engagements were now made by the Corporation staff acting as agents for the employers, who had expressed themselves in entirely satisfied with the new procedure.

The dramatic and welcome increase in the shipping load over all the ports had materially affected the Corporation's activities during the past six months. Whereas last year they were seeking to find work for the men, the present problem was to find sufficient men for the work. In the year to June last the average daily surplus of labour in the Corporation ports was 6,800; since June the daily average had been 3,100. Although daily fluctuations were considerable, they had never carried a surplus of fewer than 1,300 men. Yet, although they had that daily surplus of labour, they had also, and at the same time, reports of daily shortages from many ports. They had caused some concern and required some comment.

The surpluses were generally of short duration, because the men were wanted on the day following or the day after that. Knowing that, they could not move the men far afield. They must be within easy reach of their home port. So that, while up to June, long distance transfers from port to port were as numerous and frequent as in the previous year, such transfers of men were now exceptional; on the other hand, the number of men transferred from port to port on a daily basis had greatly increased and was now at the rate of 2,000 per week.

The Corporation, in consultation with the Ministries, had frequently reviewed the labour position. The Minister of Labour had authorised the use of unregistered labour for urgent work, and, during the last three months, they had supplied unregistered civilian labour to augment the labour force to the extent of 8,000 men-days. When civilian labour was not sufficient they had used military labour, both British and U.S.A., to meet shortages. Within the last few months they had decided to increase certain selected registers, and to date had added over 2,000 men to their labour force.

The increasing load had created new new demands for specialised workers. In the Spring the Corporation, at the request of the Ministry of War Transport, established schools at Southampton and London for training sufficient crane drivers to meet estimated future requirements; 250 men had been trained and granted certificates of competence which, after two months of approved practical experience, might be exchanged by the Corporation for certificates of proficiency.

Labour Unrest

Sporadic outbreaks of unrest had attacked several industries, and stoppages had occurred in many ports for a variety of reasons. A growing and disturbing feature of those stoppages was that they took place without the official support of the trade unions. Indeed, in their own industry the trade unions had set their face against the stoppage. But that only aggravated the significance of the movement. The unions were the accepted channel for voicing the views of the workers and for negotiating collective agreements on their behalf—and the authority of the unions must be maintained. It was as much the interest of the employers, the Corporation, and of the workers themselves as it was of the trade unions that the rule of order in industry should be established and secure.

The foundations of good order should be a sense of corporate discipline built upon mutual trust and respect, and it must be recognised that democratic freedom carried with it the duty to observe obligations undertaken in the general interest by the properly appointed leaders. That in industry meant that there must be close and continuous relationship between management and worker. The dock labour industry was faced with the peculiar difficulty that, over a great part of it, the relationship of employer and employee was of an epheremal and day-to-day character. But that emphasised rather than diminished the need for contact, which, in the docks, had been tenuous at the best, and at the worst had been non-existent.

He saw no reason why, as time went on and they developed their organisation, the Corporation should not fill that gap and act as a bridge between the allocated worker and his employers—not in competition with the unions, but supplementing, helping and working with them and the employers' organisations. That was a long-term policy, but a long-term policy was what we needed. There was no short cut and there was no royal road to industrial harmony—there must be progressive and continuous development.

The Coromandel Coast of South India

Sand Travel along the Coast. Wave Bars at the Mouths of Estuaries.

By J. M. LACEY, M.Inst.C.E.*

(Continued from page 183)

The Orientation of Surf Waves

Along the Coromandel Coast close to the shore within a distance of 400 yards, the trend of the waves does not conform to the direction of the wind, in the same way as it would in the open seas; in whatever direction the wind may be, the line of waves rolling in on to the shore has a general tendency to parallelism with the shore. The maximum deviation in both the south-west, and the north-east monsoons is about 30° with the general shore line of the coast. During the prevalence of the South-west monsoon the waves roll in on the land with a northerly trend with a possible maximum of 30° out of parallelism with the coast line, and during the prevalence of the north-east monsoon they roll in on the land with a southerly trend, and also at most 30° out of parallelism with the shore line, (see Fig. 1). In the figure the orientation of the incoming waves is shown very considerably further out at sea, than is actually the case, to indicate the maximum deviation of the incoming waves from parallelism with the coast close in shore.

Tides

The vast tidal wave from the Southern Ocean is propagated up the Bay of Bengal to the mouth of the Ganges River. Owing to the configuration of the Bay and the depth of the sea bottom, the range of tide increases with the latitude. Fig. 2, shows a chart taken from the Survey of India Department 1858—1895[4] giving approximate co-tidal lines in the Bay of Bengal. The Roman number preceding the tide gives the Greenwich times of the wave of High Water on the "Full and Change" days of the moon.

The co-tidal lines show a sharp curve, the tidal wave travelling quickest in the middle of the Bay, where the water is deepest, which would result in the flood current flowing shoreward as well as northward; and seaward and southward during ebb, which it does.

The tide levels given in Fig. 2 are taken from Tide Tables of the Indian Ocean for 1943, published by order of the Surveyor General of India. Indian standard time is the mean time of the meridian 82° 30′ East. This standard was altered on 1st September 1942, to the mean time of the meridian 97° 30′ East. In the tide table quoted above the mean time of meridian 82° 30′ East, is still retained for the Ports shown in the table on Fig. 2. Dublat is a tidal station at the mouth of the Hooghly River. Vizagapatam[5] 498 miles from Madras is built along the shore of a wide bay 5 miles across, receded from the general coastline.

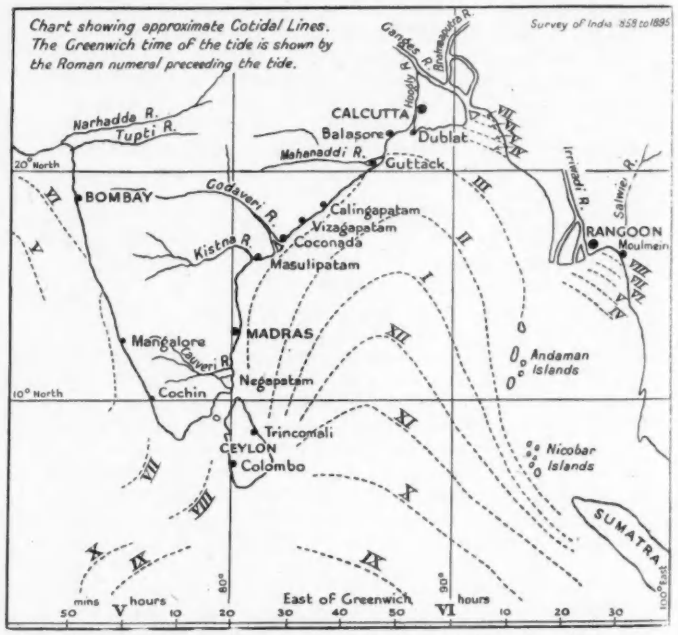


Fig. 2. Chart (on Mercator's Projection) of the Bay of Bengal.

Coconada[6] is on a salt creek in a recessed bay formed by the extension of the Godaveri River delta into the sea, east of the Port. Madras and Negapatam are open road-steads.

No accurate observations are made of the bores on the northern and eastern shores of the Bay of Bengal. The best known are those of the Hooghly River (Proc. Inst. C. E. Vol. CLX, p. 107, River Hooghly) and the Meghna River of Bengal, and the Pegu and Sittang Rivers of Burma (selected Eng. Paper Proc. Inst. C. E. No. 127 of 1932, The Sittang River).

4. On the chart which accompanied Dr. Whewell's essay on Cotidal Lines (Phil. Trans. 1833), the Coasts of India presented nearly a blank. The Governor General of India at the time (1833) requested the Asiatic Society of Bengal to promote enquiries, on the Indian Coasts, to complete the co-tidal lines for the Bay of Bengal. It was also considered that the most important branch of the investigation was that, for the determination of the "diurnal inequality," observed. (A memoir of the Indian Surveys, by H. R. Markham, 2nd Edition, 1878. Chap. xvii., "Tidal Observation").

5. See Chart on p. 276, *The Dock and Harbour Authority*, for October, 1940.

6. See Chart on p. 275—Ibid.

Tide levels at Chief Stations on Chart in Fig. 2

Standard Time—mean time of the meridian 82° 30′ E (00h is midnight, 12h is noon).

PORT	Latitude North	Longitude East	Indian Spring Low Water	Mean Low Water Spring	Mean Low Water Neaps	Local Mean Water Level	Mean High Water Neaps	Mean High Water Spring	High Water Full and Change H. M.	Mean Establishment H. M.
Negapatam ...	10° 46′	79° 51′	−0·18	+0·13	+0·67	+1·11	+ 1·55	+ 2·09	09 12	9 0
Madras	13° 06′	80° 18′	0.00	+0 39	+1·31	+1·94	+ 2·57	+ 3·49	08 19	9 1
Coconada ...	16° 56′	82° 15′	+0·20	+0·69	+1·97	+2·84	+ 3·71	+ 4·99	09 02	8 50
Vizagapatam ...	17° 41′	83° 17′	0·00	+0·49	+1·79	+2·61	+ 3·43	+ 4·73	08 38	8 26
Dublat, at mouth of Hoogly R.	21° 38′	88° 08′	+2·16	+0·85	+7·06	+9·56	+12·06	+16·28	10 17	10 4

Coromandel Coast of South India—continued

Tides in the Bay of Bengal are largely affected by diurnal inequality, which may accelerate or retard the time of High Water and Low Water, and increases or diminishes the rise. On account of the diurnal inequality, the datum of the chart at each port where the diurnal inequality is considerable, is " Indian Spring Low Water Mark."

Currents

Tidal currents are feeble. Observation taken by Mr. A. T. Mackenzie at Vizagapatam, Nov. 1898 to Nov. 1899, show the flood current to run up the Bay of Bengal with a shoreward tendency. Opposite Vizagapatam the current is deflected into the creek by a fan shaped area (see Fig. 4B.). The current is feeble, about 35 feet per minute. In the fan shaped area the deflected current increases in velocity, and enters the creek with a velocity

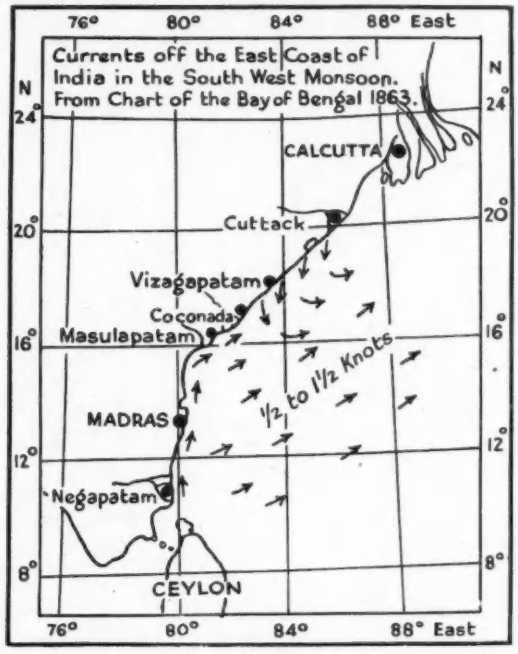


Fig. 3.

up to 2 knots as a maximum. The ebb flows down southwards with a distinct tendency seawards. The velocity in the creek is a little under 2 knots, and in deep water, as the current spreads out fanwise, its velocity is less than at flood, generally. In the north-east monsoon it is about 44 feet per mt.[7]

At Madras the tidal movement is very small and is apparent only when the littoral current to the northward has ceased. The tide as observed at Madras is described as "a gentle rise and fall of 3 to 4 feet" (Proc. Inst. C. E. Vol. CXCIV, p. 231, Coastal Sand-Travel at Madras).

The littoral currents are due to the oblique action of the surf along the coast, and to surface drift in the offing, and are sustained by the monsoons, and the prevailing local winds. The current sets to the North from March to September, and sets southward from November to January. In October and February little or no current is observed. The current is stronger inshore than in the offing.

There are occasions when disturbances at some distance south have caused violent surf currents on the coast. Lieutenant F. W. Jarrad. R.N., Marine Survey Department of Calcutta, in a survey of Madras Roadstead, October 1876, states, "Towards the end of October on one or two occasions after several days during which hardly any littoral current was perceptible, and when tidal motion was detected, there was suddenly a strong set to the northward. On this occasion the surf was higher and the sand much disturbed, discolouring the water to a depth of 4 fathoms. It was then very visible that a large quantity of sand was in suspension and was being carried along by the current."

Fig. 3 taken from the Chart of the Bay of Bengal, 1863,[8] shows currents of the East coast of India in the south-west monsoon. from Point Calimere to the mouth of the Kistna River, that is along the Coromandel Coast. Close inshore the surf current follows more or less the direction of the coast line northward. Off-shore the drift due to the monsoon has a north-east direction.

In days before the construction of the Madras Harbour, owing to the ground swell tending to cast vessels ashore, already mentioned, the best anchorage at the Madras Roadstead was in 9 fathoms, which was about 1½ miles from the shore. Cargo was carried to and from vessels by Masula boats, already described, carrying 1½ ton dead load. There were occasions, however, when the weather was unsettled, with a heavy swell rolling in, the surf was often very high, rendering it dangerous for any Masula boat to pass to and from shore. On such occasions a red and white chequered flag was hoisted at the Master Attendant's Office as a warning to the boatmen.

Movement of Sand along the Coast

Tradition states that the shore at Madras was formerly 2 or 3 miles in advance of the present line (Extract from the Records of the Government of India, CCVI P. W. D. Serial No. 5, Calcutta 1885, Papers on the Madras Harbour). There is no direct evidence in support of this statement, but before the construction of the Harbour at Madras, the sea was encroaching on the shore and at one time was washing up to the East gate of Fort St. George; and protection works had to be undertaken, (see Prof. Papers, Corps. of Engineers, Madras Presidency, Vol. II, 1846, p. 86, Repair to the Bastion at Fort St. George, Madras). The site of Madras as a trading settlement was granted to the East India Company in 1639, about which period Fort St. George was built and is stated then to be ¾ mile from the sea, (Indian Record series Vestiges of Old Madras Vol. I).

Early Observations

Observations of the bed of the sea along the Coromandel Coast show a large mass of shifting sand kept in constant motion by the surf. The loose sand extends as far as the 6 fathom line, beyond which the bed as observed at Madras, is blue clay with a moderate depth of fine sand overlying it. Fig. 4a, given in *The Dock and Harbour Authority*, of January, 1942, p. 47 (Sea Waves), shows soundings at Low Water opposite Madras City.

An enormous quantity of sand is carried along the coast within the 6 fathom contour; the direction of movement corresponding to the general direction and force of the wind.

In 1835, Capt. A. Cotton (afterwards General Sir Arthur Cotton) proposed a breakwater for Madras. In his report dated 20th June 1835 he states that the distance from the shore at which the outer surf breaks in stormy weather has been ascertained to be within 300 yards. He therefore proposed to place the breakwater at 350 yards from the shore, where there was 20 feet[9] of water at low water springs. He points out that it must be remembered that in whatever direction the wind is, the direction of the swell does not form a large angle with the beach at the distance of 350 yards from the shore; that is, at that distance the line of the swell is always not far from parallel with the coast, as it may be observed at any time when the wind is southerly or northerly, and hence it will be always nearly the same point of the beach that is most sheltered by the work. But

7. Vizagapatam Harbour Investigation, November, 1898, to November, 1899, Government of Madras Publication.

8. Lieutenant A. D. Taylor, of the Indian Navy, compiled a chart of the Arabian Sea, with great care, showing the winds and currents during the south-west monsoon, by a comparison of upwards of a hundred logs of vessels of the Indian Navy (published in 1853 with a memoir), and Lieutenant Heathcote made a similar wind and current chart for the Bay of Bengal. Lieutenant Heathcote's chart was sent to the India Office, and is printed together with the memoirs which accompanied it, in the Journal of the Royal Geographical Society for 1862. (See a "Memoir of the Indian Surveys," by C. R. Markham, 2nd Edition, 1878, pp. 29 and 36).

9. A sufficient depth for ships at that time.

Coromandel Coast of South India—continued

whether the swell comes rather from the northward or rather to the southward of east, the extent of beach to be sheltered will not be less than when it comes directly from the eastward. That current alone being moderate would have little effect on the sand if it remained undisturbed by the surf; it is this combined action of the surf and current whch causes such rapid changes in the sand. The surf keeps the sand suspended in the water, and the current carries it away with it. Later, in a report on groins at Vizagapatam, on 30th May, 1843, he writes "The effect of the current on the sand is very small, quite insignificant in comparison to that of the wind." In whatever direction the surf strikes the beach (which will always have some slight degree of obliquity) in the same direction the sand will be carried forward, even though the current may be the opposite way. In a report dated 26th August, 1844, to the Secretary of the Military Board, he states, " The movement of the sand depends solely upon the direction and force of the surf; simply because the force of the current along the shore is nothing compared with the surf."

Regarding the height of the proposed breakwater, Capt. Cotton states " I am not so sure that it will be found necessary completely to stop the waves from rolling over the work, for wherever there are banks or reefs from 3 to 6 feet below water, the force of the swell is entirely expended upon them." Hence he concluded that if the breakwater was brought to within 3 or 4 feet of the surface, the swell would be so effectively broken that there would be a very slight wave within the work, and only a ripple on the beach. In a further report dated 11th November, 1837, Cotton states, in support of the above statements, " that islands that have coral reefs running parallel to the shore at a moderate distance, although never rising much above the level of the sea, yet always keep the water perfectly smooth between them and the coast." He also quotes the Armogan Shoal and Blackwood's Harbour (see *The Dock and Harbour Authority* of October, 1940, p. 275, " Harbours and Ports of the Circar and Coromandel Coasts ") in support of his proposal, and states that a vessel was anchored in Blackwood's Harbour in the monsoon, and communication with the shore was very easy compared with Madras.

Capt. Cotton conceived an open straight line of coast with a straight or slightly curved breakwater for vessels to anchor behind would be a more convenient shelter for ships than almost any natural harbour; vessels could come in and go out in all winds. He was perfectly confident in his proposals for a breakwater at Madras or he would not have proposed it. (Professional Papers, Corps. of Engineers Madras Presidency, Vol. I, Madras 1839, "Report on the proposed breakwater at Madras" and Vol. II, Ibid., 1846. Maj. Cotton's report on the groins at Vizagapatam).

In connection with Major Cotton's report on the encroachment of the sea at the town of Vizagapatam in the Prof. Papers Corps. of Engineers, quoted above, p. 181 of Vol. II, in a letter dated 30th May, 1843 to the Secretary Military Board, Cotton states, 2,000 yards north of the Fort is a rock projecting 500 feet from the general line of the high permanent sand drift; 80 feet of the extremity of this projection is of open stone which seems to prevent the accumulation of sand. Within it there is a solid bank of sand, level with the wash of the surf at high wter spring tides, extending 1,100 yards; by this the sea seems to be effectively prevented from encroaching all along this part of the beach. About 1,200 yards from the rock the town commences, and the sea is washing quite up to the houses along the whole length, having carried away the front line for a considerable distance near the Fort. The accumulation of sand is found only on the south side of the rock. On the north immediately beyond the natural groins, the sea washes up the high sand drift. (Fig. 4B).

In a letter dated 26th August 1844 to the Secretary of the Military Board, Cotton states that the effect of the North-east monsoon on the sand generally along the coast, is quite insignificant in moving it southward, in comparison with the south-west monsoon in the opposite direction. Though there is some little time during which there is a heavy surf from the northward just at the setting in of the north-east monsoon, which must move some sand to the southward, yet this effect is very slight, and there is

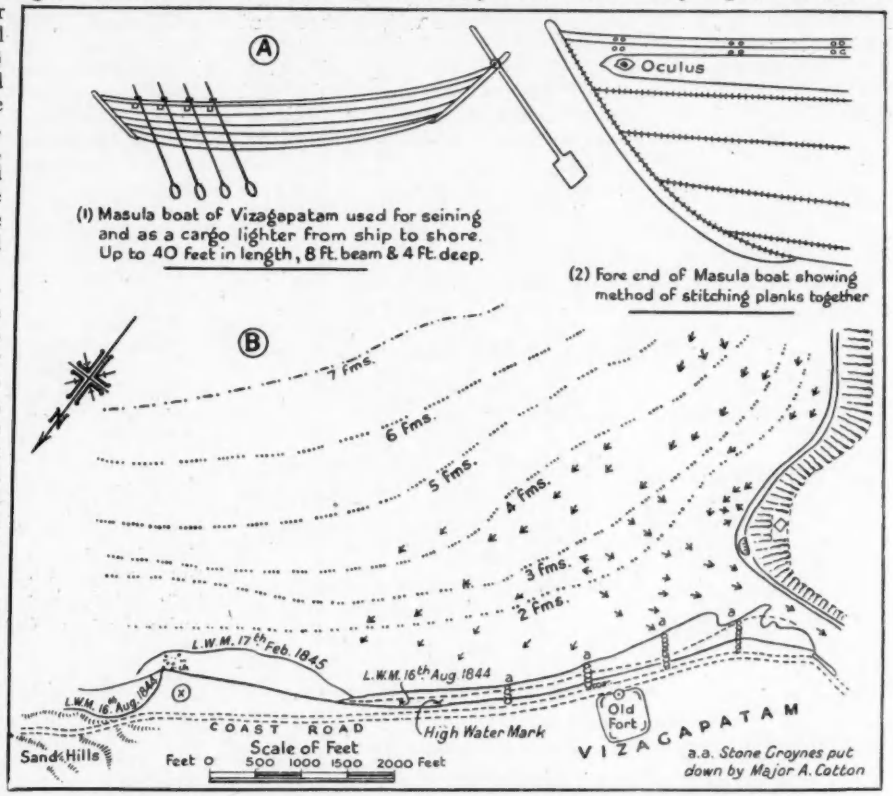

A
Oculus
(1) Masula boat of Vizagapatam used for seining and as a cargo lighter from ship to shore. Up to 40 Feet in length, 8 Ft. beam & 4 Ft. deep.
(2) Fore end of Masula boat showing method of stitching planks together
B
7 fms.
6 fms.
5 fms.
4 fms.
3 fms.
2 fms.
L.W.M. 17th Feb. 1845
L.W.M. 16th Aug. 1844
L.W.M. 16th Aug. 1844
COAST ROAD
High Water Mark
Old Fort
VIZAGAPATAM
Sand Hills
Scale of Feet
Feet 0 500 1000 1500 2000 Feet
a.a. Stone Groynes put down by Major A. Cotton

Fig. 4. Survey of Vizagapatam Roadstead, 1898-9, showing direction of currents at flood tide. Datum of Soundings: Indian Spring Low Water.

in consequence a very great balance in favour of the sand moved by the south-west monsoon, so that on the whole, the sand is continually carried northwards, and consequently when there is a promontory like the Dolphin Nose which in a great measure cuts off the supply of sand from the southward, the sea must necessarily encroach on the shore to the north of it, unless stonework is thrown out to prevent it. I have no doubt that this preponderance in the effect of the south-west monsoon is also found at Madras.

At the ledge of rocks forming a natural groin (see x, Fig. 4B) already mentioned there is a hollow in the beach on the North side of it. This was not filled up at all in the north-east monsoon; that is the line of High Water was scarcely at all altered, but it became shallower so that the line of Low Water was further out as shown in Fig. 4B, but this deposit of sand takes place, all along the coast as well as in the hollow, in fine weather. (Prof. Paper, Corps of Engineers, Madras Presidency, Vol. II., 1846, Major Cotton's report on groins at Vizagapatam). The observation made at Vizagapatam on the Circar Coast are relevant to the movement of sand along the coast.

(To be continued)

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

Buoys and their Moorings

An Article for Students and Junior Engineers

By STANLEY C. BAILEY, Assoc.M.Inst.C.E., F.G.S.

Purposes of Buoys and Beacons

FLOATING buoys and beacons for safe navigation purposes are generally used for (1) marking the safe navigable boundaries in passages between shoals at river mouths, estuaries, and channels at the entrances to ports and harbours; (2) indicating the edges of open sea shoals and sandbanks, in addition to the use of lightships; (3) fixing the positions of submerged shipwrecks, rocks and other obstructions, and marking the positions of sewer outfalls, submarine electric cables, depositing grounds for dredgings and ship anchorage areas for quarantine purposes; and (4) mooring vessels in harbours, ports and rivers.

When lighted buoys are provided, the strongest lights are required on those that mark sea shoals, while those showing the positions of wrecks and rocks need not be so powerful, and still smaller lights are employed on channel buoys, and on those used for mooring large vessels.

The largest buoys are employed for sea and estuary shoals, so that they may be visible in rough seas, smaller ones being used for channels, and still smaller as mooring buoys, with the exception of those for mooring large ships.

Buoy Types

In the diagrams Figs. 1 to 36 various types of buoys are shown that are required for particular situations, and the cross-sections illustrated by Figs. 20 to 24 and 28 show the arrangement of the plating and the position at (D) of the diaphragm plate and manhole (M.H.); although small buoys are not always provided with diaphragms, it is advisable that they should be, to guard against damage and leakage.

Figs. 30 to 36 show mooring buoys fitted with either vertical or horizontal diaphragms.

Channel buoys are divided into two classes. In the first class they are 8-ft. diameter and 10 to 12-ft. high, or of larger sizes. A can or truncated cone shaped port buoy (Fig. 1), 8-ft. diameter at base, 6-ft. diameter at the top and 11-ft. high with $\frac{3}{8}$-in. upper and $\frac{1}{2}$-in. lower plates will weigh about 3.25 tons, and if x is the height of the C.G. above the bottom of the buoy and H the total height, then $x = H.0.507$. A cone-shaped or starboard buoy 8-ft. diameter and 12-ft. high (Fig. 2) will weigh 2.56 tons, and $x = H.0.388$. The mooring chains are of $1\frac{1}{4}$-in. diameter bar iron.

Second class buoys are 6-ft. diameter and 8-ft. 6-in. to 10-ft. high, a can-shaped one 6-ft. diameter at base, 4-ft. diameter on top, and 8-ft. 6-in. high, with $\frac{1}{4}$-in. upper and $\frac{3}{8}$-in. lower plates will weigh 1.32 tons, while a conical buoy 6-ft. diameter and 10-ft. high will have a weight of 1.18 tons, the mooring chains being of 1-in. diameter bar iron.

The sinkers should be at least equal to the weight of the buoys.

Channel buoys are usually numbered from the channel entrance inwards towards the port; the odd numbers are on the port or left side, and the even on the starboard or right side, as the vessel enters the port. According to the British Regulations, the buoys on the port side should be of the truncated cone or can-shaped type (Fig. 1) with a staff and open metal-work triangle or truncated cone-shaped cage on top, the buoy being painted either black, or with white and black chequered squares; in some ports they are red and white, or have vertical black and white stripes, while lighted ones should show a white light.

The starboard buoys (Figs. 2 and 3) are of the conical or nun type, having a staff carrying an open metal-work globe, and are painted red, while those that are lighted should exhibit a red light.

Most large foreign ports adopt the British Regulations as to shapes and colours of the buoys used, but in small British and foreign ports there are also minor regulations as to shapes, sizes and colours.

The buoys marking the outer ends of shoals and middle grounds between two channels are hemispherical above the water line, where there is a waist with a bulge at the base, they are known as "dome" or "spherical" buoys (Fig. 4), and are surmounted with a staff and diamond-shaped open metal-work frame to act as a beacon. They are painted with black and white horizontal or vertical stripes or bands; while those used for the inner ends of middle ground shoals are similar in size and shape to the outer ones, except that the staff is crowned with a slotted metal triangle (Fig. 5) and the buoys are painted with red and white horizontal bands or vertical stripes.

They are sometimes marked with figures giving the depth of water at L.W.S.T. Spherical buoys are also used for indicating the position of outlying spits and banks. They have a staff with a cage or triangle on the port side, and are painted with black and white rings; those on the starboard side have a staff and open metal-work globe 2-ft. in diameter, and are painted with red and white rings.

The original form of "nun" buoy consisting of double cones with the bases united at the diaphragm (Fig. 6) is a fairly stable type and suitable for resisting the strain of the cable.

Spar buoys (Fig. 7) are usually of the conical or nun form with a conical or hemispherical base; they are fitted with a long timber spar from 6-ft. to 9-in. diameter which passes through the buoy and projects about 8-ft. above it, and 12 to 13-ft. below, the mooring ring being attached to the lower end of the spar; they are suitable for channels in which there is much fast moving drift ice during the winter.

In another form of spar buoy (Fig. 8) the spar only extends from the diaphragm plate to above the top of the buoy for 10 to 12-ft., being stayed with iron rods to the periphery of the buoy.

Two forms of can buoys are shown by Figs. 9 and 10, and the conical one (Fig. 11) with a flat base plate and triangular steel framework below with mooring ring is known as a "spider legged buoy."

Pillar, or beacon buoys are illustrated by Figs. 12, 13 and 18. These are usually of the can type with convex bases and have a framework of steel mounted on the top, about 10 to 15-ft. high, crowned with an ironwork sphere or triangle, or a light may be fixed. Automatic syrens operated by compressed air are also used on these buoys, which require to be well ballasted with concrete to keep them upright.

Watch buoys are can shaped with the vessel's name on them in large white letters, followed by the word "watch" and are painted red. Those that show the positions of dredging deposit areas at sea are conical and are painted with black and yellow vertical stripes. Pillar buoys are also used for this purpose and those indicating the positions of submarine telegraph cables, sewer outfalls, etc., are painted black. Whistling buoys (Fig. 14) are generally of conical form with hemispherical bases. They are about 9-ft. 6-in. diameter and 13-ft. high with a horizontal diaphragm above the floating water level. A steel tube 2-ft. 6-in. diameter and $\frac{3}{8}$-in. thick passes through the axis of the buoy for a few feet above the diaphragm and projects about 30-ft. below the base, the lower end being open to the water, the top of the tube is closed by a plate above the diaphragm and water level, and between the plate and the water level, two small air pipes (A) are fixed leading from the top of the tube with air inlet valves at V, to the top of the buoy. The water in the main tube will then stand at the same level as that on the outside of the buoy. When the buoy rises on the crest of a wave the air in the tube expands and a partial vacuum is produced, which causes the air inlet valves to open, and the tube fills with air. Then as the buoy sinks in the trough of a wave, the air is compressed and the air inlet valves close, so that the compressed air is forced into a pipe connected

Buoys and their Moorings—continued

to the main tube below the plate with a valve at V and terminating at the top of the buoy in a metal reed whistle (W). The larger the air space in the tube, the heavier the buoy, and the higner tne waves, the greater will be the volume of sound emitted.

The mooring ring, or shackle, at the base of the buoy is fixed near the tube or may be attached to an iron band round the tube and secured to it by stud bolts. A handrail (R) is provided at the top and a ladder or step irons up the buoy.

For some types two main tubes are used being fixed parallel to the axis of the buoy. They are connected together below the top plates of the tubes by a ball valve box and vertical central pipe to the whistle. The air enters the tubes through pipes leading from the outside of the buoy to the valves, and the operation is similar to that in cases where a single tube is employed. The advantage of using double tubes is that the volume of sound emitted is greater and the mooring ring is central in the base of the buoy. Some whistling buoys are also fitted with lights, but they can only be used in situations where the depth of water at L.W.S.T. exceeds 35-ft. Whistling and bell buoys only operate satisfactorily in rough seas, when the sounds emitted may be heard for several miles, depending on the direction of the wind.

Buoys that mark the edges of shoals, rocks and ledges, have usually the name of the particular obstruction painted on them, and also a number, while those showing the positions of shipwrecks on the port side are can shaped (Fig. 16), with a staff and metal triangle or cage, and are painted green, with the word "wreck" in large white letters; when lighted they show two green flashes. On the starboard side they are conical with a staff and metal globe; in other respects they are similar to port buoys but exhibit three green flashes when lighted.

In some cases the starboard buoy is can shaped with a bulge at the base and is surmounted with a large open metalwork globe, having the word "wreck" painted on a metal band round the periphery (Fig. 15). The advantage of putting a large bulge at the base of the buoy, as in Figs. 4, 5, 15, 17, 19 and 21, is that it assists in steadying it, especially when ballasted.

Fig. 17 shows a form of buoy required to mark a special position. It is surmounted with an open ironwork domed cage, and is a fairly stable type, while Fig. 19 illustrates another form of channel port buoy.

With regard to the bases of buoys, those that are hemispherical (apart from those with wide bulbous bases) are liable to roll considerably, and various devices have been used to steady them in rough seas, such as adding a keel plate, or ballasting with concrete. But this expedient lowers them too much in the water to be visible, and is more suitable for beacon, pillar, or lighted ones; for instance, a steel buoy with a hemispherical base will require about twice its weight in ballast to enable it to float upright, when floating freely without a chain, although the weight of the chain assists in keeping it vertical, while can and conical buoys with cylindrical bases will require about 2¼ times their weight in ballast.

Cone-bottomed Buoys

Most modern buoys have their bases constructed on the Herbert system and are known as "cone-bottomed buoys," in which the bases are made deeply concave or cone shaped (Fig. 23), the mooring ring being attached under the apex of the cone, on the top of which is a diaphragm plate. For stability purposes, the mooring ring should be attached as near the C.G. of the buoy as possible, but this is not always practicable. The cone or concave form of the base strengthens it considerably against the pull on the chain, and assists in steadying the buoy in rough seas.

Buoys on Stoney System

Buoys have also been constructed on the Stoney system and are called "keel buoys." In these the lower portion is cylindrical with a flat bottom, the periphery plates are extended 18-in. below the bottom for 6-ft. diameter buoys, and 20-in. for those 8-ft. in diameter (Fig. 24), to act as a circular keel, the lower edge being protected by an angle iron. Holes are drilled in the periphery just below the bottom plate to allow air to escape; the mooring ring is fixed in a malleable iron casting riveted to the bottom; the keel has a considerable steadying effect and is used on some lighted buoys of cylindrical form.

Bell Buoys

Bell buoys are usually more or less hemispherical with flat tops. In some the bell is fixed to an internal tripod, just above the top of the buoy, and above the bell is a concave metal cap or "sounding board" 2-ft. in diameter, supported by 4 stanchions, and 5-ft. 6-in. above the top of the buoy (Fig. 25). The 4 clappers that strike the outside of the bell mouth are suspended by Y-shaped rods pivoted to the circumference of the concave cap. The bell is of a bronze alloy or bell metal and may weigh from 3 to 7-cwts., according to the size of the buoy. A buoy 9-ft. in diameter, with 8-ft. diameter deck, and 6-ft. high, with a 4-cwt. bell would weigh about 3 tons.

In another arrangement shown by Fig. 26, the bell is fixed to a concave metal "sounding board," about 7-ft. in diameter, supported on 4 stanchions, about 8-ft. above the top of the buoy. The 4 clappers are suspended from pivots on the underside of the concave cap, near the periphery, and to increase the force of the blows of the clappers, long rods, which reach nearly to the platform of the buoy, are pivoted to the rim of the concave cap opposite each clapper, and terminate at the lower ends in weights that swing between guides on the deck of the buoy. The clapper rods and the long weighted rods are connected by horizontal pivoted bars, giving parallel motion. A staff with an open metalwork triangle or cage for port, and globe for starboard buoys, is fixed to the top of the sounding board, and sometimes a light is provided in which case the gas cylinder container (G) is fixed in the buoy. The buoy shown in Fig. 26 is 16-ft. in diameter with a deck 14-ft. diameter and is 10-ft. high, exclusive of the superstructure.

Luminous Buoys

Figs. 27, 28 and 29 illustrate gas-lighted buoys. Fig. 27, is the pillar type having a cylindrical buoy 7-ft. diameter and 10-ft. high, and contains four steel cylinders of dissolved acetylene mixed with acetone; the gas generated is sufficient to light the buoy for 12 months without much attention. Some are arranged with a valve actuated by clockwork which automatically cuts off the light during daylight, leaving only a jet burning.

The lantern is from 12 to 15-ft. above the water level, supported on a steel framework with a ladder, the buoy being ballasted with concrete. Oil gas-lighted buoys on the Pintsch system are usually of the spherical type, about 9-ft. 9-in. diameter with a 12-in. deep waist, and bulge at the base 10-ft. 9-in. diameter and height of 11-ft. 9-in. (Fig. 28). The lower portion is the gas container and it is divided by a circular diaphragm into an inner chamber (I) and an outer one at (O) with manholes (MH) and connecting pipes (P) to the lantern.

The plates of the gas reservoir are usually electrically welded together, as this portion must be quite watertight. When oxy-acetylene or electric welding is done, the edges of the plates are bevelled. They are then butted together and the V-shaped space between the plates is filled with molten metal. This portion of the buoy is tested under hydraulic pressure to 150 lbs. per sq. in. (9.64 tons per sq. ft.).

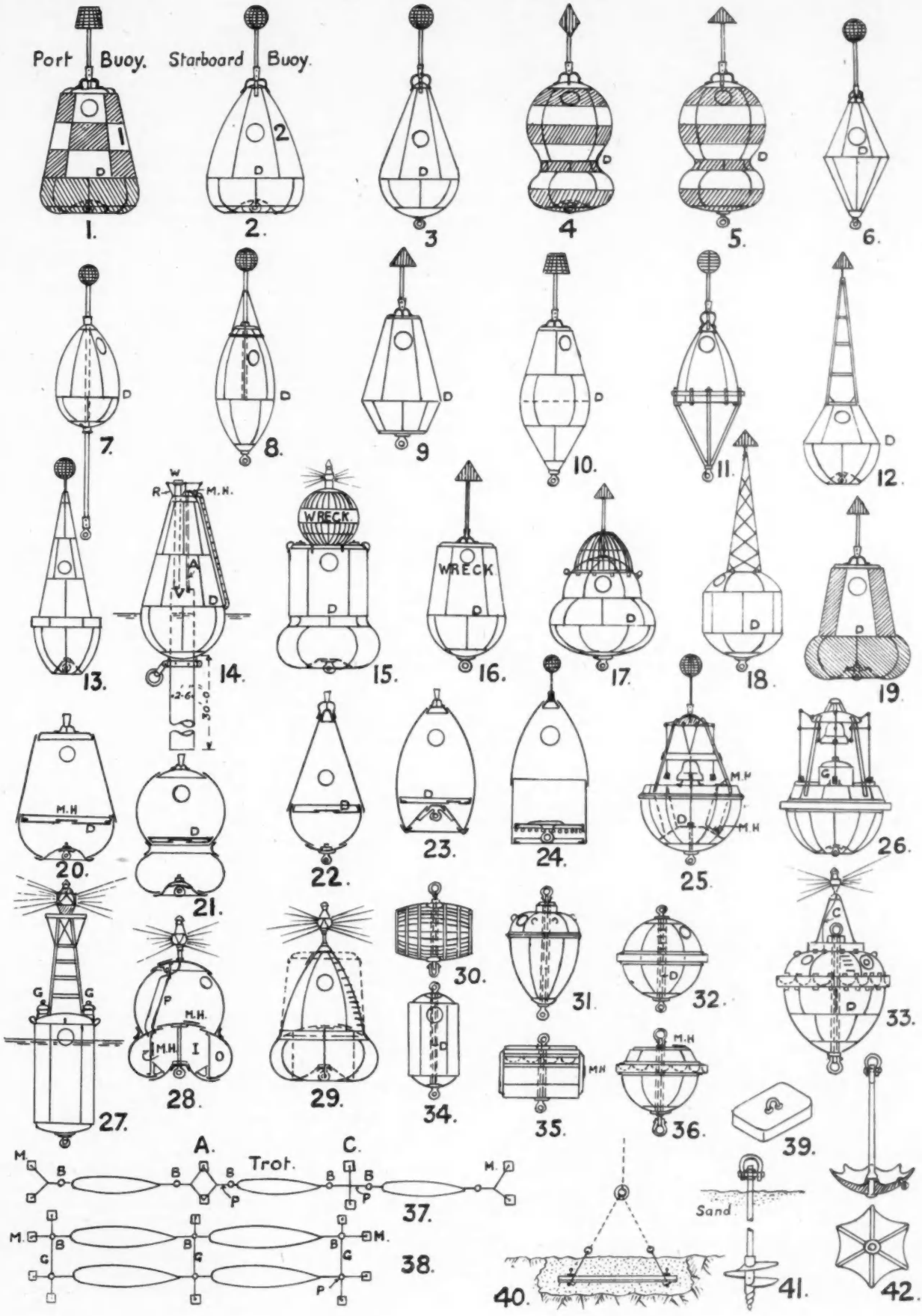
The oil gas is vapourised paraffin, but a mixture of 20% acetylene gas and 80% of oil gas will double the illuminating power.

The oil gas is compressed to from 5 to 6 atmospheres (73.5 to 88.2 lbs. per sq. in. respectively) and will burn for 2 or 3 months, according to the size of the gas container, the consumption of gas being 0.75 to 1 cub. ft. per hour.

Fig. 29 shows a lighted conical starboard buoy, 8-ft. 9-in. diameter at the base of the cone, and 10-ft. 9-in. diameter in the bulbous portion, and 13-ft. 9-in. high; while the broken line is a can or port buoy 12-ft. high.

Electrically-lighted buoys, in which the light is produced by electric batteries or accumulators, are sometimes used, especially on mooring buoys.

They require more attention than gas-lighted ones, and electric lights have a lower penetrating power in foggy weather than the yellowish lights of gas buoys.


Port Buoy.
Starboard Buoy.
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Buoys and their Moorings—continued

Mooring Buoys

Mooring buoys, Figs. 30 to 36, are generally constructed of steel plates, and have flat tops and hemispherical bases, or they may be of the can and cylindrical forms to float either vertically or horizontally; spherical forms are also used (Fig. 32).

Barrel buoys (Fig. 30), constructed of creosoted pitch pine, oak or elm timber are often provided for small craft. They are usually about 5-ft. long and 4-ft. in diameter, although larger sizes are also used; the staves are 1¼-in. thick, and are bound together with 2¾-in. by ½-in. hoop irons, a rod 1½-in. diameter passes through a 3-in. diameter tube in the buoy, and terminates at each end in an 8-in. diameter ring of 2-in. thick metal. The top ring is screwed to the rod and locked with a pin, or a shackle may be provided at each end. Sometimes the mooring chain passes through the buoy.

In all mooring buoys the ring bolt should pass right through them in a tube, and in large ones, hand irons, life chains, and timber fenders are usually provided.

The buoy in Fig. 31 is 7-ft. diameter and 8-ft. high, and the spherical one, Fig. 32, is 5-ft. 6-in. diameter, while that shown by Fig. 33, is 14-ft. diameter and 10-ft. high and is provided with electric light.

Construction of Buoys

For the construction of buoys, the full size of the particular buoy is drawn out on the floor of a moulding loft, from the working drawings, and assuming that the buoy is a truncated cone (Fig. 1) or conical (Fig. 2) produce the sides until they meet at the apex point, and in the case of Fig. 2 in which the sides are curved, draw some horizontal section lines across the cone. Then the radii for the curves at the base of the cone or at any of the section lines, will be from the apex point to the points at which the section lines cut the inclined sides of the cone. This will give also, on the sloping lines, the net length of each plate, and the net width of each plate measured on the curves will be equal to $\frac{D \times 3.1416}{6}$, where D is the diameter of the cone at any horizontal section, for 6 plates on the circumference. The curve at the base of the conical part of the cone will also be the curve for the lower hemispherical portion on top, the lengths of the lower plates being measured on the curved side, and the widths of each plate obtained in a similar manner to those of the conical portion. The top of each plate will therefore have a concave curve, and the bottom and sides, convex curves. In cones with straight sides, as in Fig. 3, only the upper and lower edges of the plates will be curved, and the diameter of the bottom plate should be measured on the curve of its shape.

To allow for rivet holes, the centres of which would pass through the edges of the plates, and also for lap, 1¼-in. should be added to the sides of the plates; a template of sheet iron, with the rivet holes punched out may then be cut.

The plates for buoys are usually rolled to shape while cold, or pressed to the required form in an hydraulic press. Those for the upper portion are ¼-in. to ⅜-in. thick, and for the lower submerged part ½-in. to ⅝-in. with a ⅝-in. bottom plate in large buoys, the plating being arranged in 6 or 8 sections according to the size of the buoy. Outside plates lapping over inside ones from 2-in. to 2½-in. with packing strips on the inside, where the junctions are made with the top cover of the buoy and the diaphragm plate, or the inside plates may be thinned down at these joints, and packing strips omitted. A single line of rivets is used, the pitch of which should not exceed three times the diameter of the rivet for watertight work, and all plates should be well caulked. The rivets should have pan-shaped or semi-circular heads and be ½-in. to ⅝-in. diameter for the upper plates, and ⅝-in. to ¾-in. diameter for the lower ones. For rivet heads allow 3% on the weight of the plating for ¼-in. plates, 2½% for ⅜-in., and 2¼% for ½-in. plates.

Buoys should have a horizontal diaphragm plate above the water level with an 18-in. diameter manhole, a similar manhole being required near the top, or in the top plates of can buoys.

Diaphragm plates are ⅜-in. to ⅝-in. thick, according to the size of the buoy; in small ones they may be in one circular piece with turned-up edge and a central manhole, or the periphery joint may be made with an angle iron, while in larger ones the diaphragm may be in radial sections, the joints being either lapped, or butted together and joined with a 5-in. wide cover plate. The manhole cover should be bedded on an asbestos or composition ring steeped in boiled linseed oil, or in red lead, and fixed with stud bolts and winged nuts.

A connection will be required for testing purposes, the buoys being tested under hydraulic pressure to 12 lbs. per sq. in. (0.77 ton per sq. ft.). Mooring rings are from 6-in. to 8-in. internal diameter and 2-in. to 2½-in. thick, forged on 9-in. or 12-in. by 3-in. cross-bars from ⅝-in. to ⅞-in. thick, which are riveted to the underside of the bottom plate and curved to fit.

On the top of the buoy, a three or four-legged forged or malleable cast iron staff holder or crown is fixed, consisting of a tapered square tube 12-in. long with a 2½-in. square hole, having two winged screws on two sides to hold the timber staff. The legs stand about 9-in. above the top of the buoy and are about 2½-in. by ¾-in., bent to shape required, and riveted on; they are also used for the attachment of lifting tackle.

Channel buoys have been constructed in fine reinforced concrete 3½-in. thick; they are cylindrical or of can shape, about 6-ft. diameter and 10-ft. high with flat tops, and concave coned bases. The iron reoinforcement is central, and consists of vertical rods ⅝-in. diameter, and 12-in. pitch, with horizontal ring rods ¾-in. diameter and 6-in. pitch, covered with expanded metal, or with hyrib rods between them. The mooring chain eyebolt passes through the apex of the coned base and terminates on top of the cone in another ring or shackle used for lifting the buoy by a chain passed through the top manhole. When it is floated the manhole is covered with a reinforced concrete slab cemented down and coated with bitumen.

A small hole with a brass-screw cap is provided on the top of the buoy with a pipe inside reaching to the bottom so that leakage water may be pumped out.

A buoy of the size given weighs about 4½ tons, and 1 ton of ballast is required to make it float upright, while the cost is about half that of steel ones

In mooring buoys the chain sometimes passes through the buoy to the top ring in a tube with thick flanged ends to provide for wear from the chafing of the chain, the flanges being bolted or riveted to the buoy on the outside; but usually the upper and lower rings or shackles are pivoted to a steel rod from 1½-in. to 2-in. diameter, passing through a 3-in. to 6-in. diameter tube in the buoy, the pins in shackles, and the rods being of similar diameter.

The diaphragm plate is generally vertical, and is fixed by an angle iron to the periphery of the buoy, and welded to the central tube; a manhole being required in it, and also at the top of the buoy.

Ground Moorings for Buoys

Buoys that mark the positions of shoals and channels are usually moored by chains attached to cast-iron rectangular or oval sinkers (Fig. 39) weighing from 13 to 30-cwts. each, the heaviest being used for open sea shoals. The steel half-ring in the sinker is 6-in. to 8-in. diameter inside and 2-in. to 2¼-in. bar diameter. In rough seas, unless heavy sinkers are used, they are liable to be dragged out of position if they do not sink deeply into the sand, or mud, as the weight of iron in sea water is $\frac{1}{7}$ to $\frac{1}{7.5}$ times less than in air.

If W is the weight of the material in air, then its weight (w) in sea water will be as follows, viz.: steel at 490 lbs. cub. ft. $w = W \times 0.873$; wrought iron (480 lbs.), $w = W \times 0.866$; cast iron (450 lbs.), $w = W \times 0.857$; and concrete (140 lbs.), $w = W \times 0.542$.

A steel truncated cone or can buoy 9-ft. 6-in. diameter at the base and 6-ft. diameter at the top, with a height of 13-ft., will weigh about 3 tons and its buoyancy will be $3 \times 35 = 105$ cub. ft., so that it would float if upright with 2-ft. draught. The weight

Buoys and their Moorings—continued

of a 60-ft. or 10 fathoms 1¼-in. mooring chain at 84 lbs. per fathom will be 840 lbs., and $840 \times 0.866 = 727.4$ lbs., weight in water, and $\frac{727.4}{64} = 11.3$ cub. ft. of additional water displaced by the buoy. This will increase the draught by 2-in. Should the buoy be sufficiently buffeted about by the waves to lift or drag a cast-iron sinker weighing 1.5 tons, the weight of which in water will be $1.5 \times 0.857 = 1.28$ tons, then $1.28 \times 35 = 44.8$ cub. ft. additional water will be displaced by the buoy, giving an extra draught of 8-in.

To prevent the possibility of the sinker being lifted, the length of the chain cable is made 1½ times the depth of water at H.W.S.T. or twice the depth at L.W.S.T. Sometimes 3 times this depth is allowed, as the chain assumes a parabolic curve.

Large buoys marking mud and quicksand banks are sometimes moored to mushroom anchors similar to Fig. 42, also used for lightships.

The shank or stock of the anchor is of forged iron or steel from 6-in. to 9-in. diameter and about 6 or 8-ft. long, with a shackle and pin of 3-in. diameter, iron at the end; the head or crown is of malleable cast iron 6-ft. in diameter, shaped like an open umbrella, which sinks well into the sea bed.

Concrete blocks 3-ft. cube (1.6 tons), 5-ft. by 5-ft. by 3-ft. (4.5 tons) and 6-ft. by 6-ft. by 3-ft. (6 tons), having a ring bolt, with shank and large washer embedded in the concrete, make good sinkers.

The chains should have a shackle and swivel at both the buoy and sinker ends.

When the sea bed consists of firm sand, screw piles are often used. The shafts of these are of solid steel 6-in. diameter, and 10-ft. long, or more, according to the nature of the ground; the screw is formed of cast steel with a single thread 2-ft. 6-in. to 4-ft. diameter and 8-in. or 9-in. pitch, and the pile is pointed at the base (Fig. 41).

Long rods 6-in. diameter, are either coupled or screwed to the top of the pile, and it is driven down by an electrically-worked capstan head fixed to the top of the pile rods above the water level. The pile rods pass through a 7-ft. square well in a lighter or barge, which is securely moored over the site by four or more chain anchors.

When the pile has been driven to the required depth, and the top is about one foot above the sea bed, the steel driving rods are removed, and a collar is screwed on top of the pile. Then a cross-bar with a hole in the centre is dropped on, and held by lock nuts, the cross-bar being free to revolve. To this is attached a shackle for the chain.

The moorings for ships in ports and harbours when arranged in single file are known as " trots." The arrangement of the cables and buoys is shown in the plan, Fig. 37, where the ground moorings are shown at M, the pendant chains at P, and the buoys at B.

In Fig. 38 the moorings for a double line of vessels is shown.

The fixing of the chain cables must be very secure; in some cases where the ground is soft, long creosoted timber or reinforced concrete piles, 14-in. to 16-in. square are driven down until they project about 1-ft. above the sea bed, by means of a " follower " or " dolly " on the pile, from a floating pile driver, or a deeply-driven screw pile may be used; in timber and concrete piles the shackle is fixed to a 3-in. diameter bolt through the pile head, which should be capped with cast iron, or 7 lbs. per sq. ft. sheet lead when timber piles are used. In some cases concrete foundations from 20 to 30-ft. square, and 8-ft. thick are employed, the concrete being deposited in a pit grabbed out of the sea bed. If the ground consists of shale or rock, then holes about 12-ft. square and 7-ft. deep are blasted in it, cleared out, and trimmed by divers, with the assistance of a grab dredger (Fig. 40).

A square framework of steel railway rails or rolled steel joists with an eyebolt 6-in. inside diameter and 2-in. thick, and chains 1⅝-in. diameter at each corner is then dropped in each hole, which is then filled with 1-2-3 cement concrete by means of buckets from a barge. Short bridle chains are shackled to each eyebolt and to a ring 12-in. inside diameter and 2½-in. thick, to which the 2½-in. or 3-in. diameter pendant chain of the buoy is attached.

In some ports where a diving bell is available, the rock is drilled out for blasting, or broken up by men using chisels and sledge hammers, working in a diving bell of rectangular shape, about 10-ft. by 6-ft. by 6-ft. 6-in. high, slung by 4 chains from a ring to which the hook and sheaves are attached of a heavy crane jib on the bow of a wreck raising lighter, fitted with a steam winch, air compressing pumps, receiver, and an air pipe fixed to the top of the bell. When the bell is removed, the broken rock is picked up by a grab dredger, and the concrete deposited by skips or buckets with hinged bottoms and levelled off by divers.

In Fig. 37 two forms of ground moorings are shown; at " A " there are diagonal bridle chains, and at " B " there are cross chains to which the pendant chains (P) are attached; and in Fig. 38 there is a cross ground chain (G) between the mooring points with rings to which the vertical pendant chain (P) is fixed with shackles and swivels.

Stud link chains are generally used, the ground chains being 2¾-in. thick having shackles every 75-ft. with 2⅛-in. thick bridle chains and 2½-in. to 3-in. diameter pendant chains to the buoys.

In moorings of inferior type, anchors are used in lieu of concrete or other more secure foundations.

To fix the position of buoys, the points at which they are required are laid down on a chart corrected to date. These points are triangulated with two or more prominent objects on the shore a good distance apart, and the apex angles which the buoys make with them are calculated or measured. The buoys with chains and sinkers attached are then taken out to sea in a vessel fitted with a crane or derrick and their positions are fixed by taking bearings with a sextant on prominent shore points, and manœuvring the vessel until the given apex angle can be read off. It is advisable to check this by taking additional bearings, and also soundings, before the buoy with sinker and chain attached is dropped overboard.

The National Council of Port Labour Employers

Change in Title and Constitution

A Press Conference was held in London on December 9th, at which certain changes in the constitution of the National Council of Port Labour Employers were announced. The title of the Association has been altered to **The National Association of Port Employers.**

The Council was formed in 1919 to represent employers of dock labour in negotiating with the Unions concerned the National Docks Agreement of May 1920, which followed closely upon the Report issued by the Court of Inquiry, presided over by Lord Shaw, into the wages and conditions of dock labour. The Council has represented dock labour employers in the negotiation of all national agreements since that date.

The constitutional changes, to which it is hoped to refer in greater detail in a future issue, are designed principally to strengthen the Association's regional organisation; this takes the form of Groups, each representative of port interests within its area and equipped with its own secretariat. The scope of the Association in its new form will be even more comprehensive than heretofore, as provision is made for the affiliation to it of national and central bodies with associated interests.

Members of its executive will, together with representatives from the appropriate Unions, form as hitherto, the National Joint Council for Dock Labour.

FOR SALE.

3-TON CAPACITY ELECTRICALLY OPERATED FIXED LUFFING AND SLEWING CRANE BY SIR WILLIAM ARROLL; new 1928, having lattice steel cantiliver jib, capacity 3 tons at 40-ft. radius, fitted with motors for lifting, luffing and slewing all for 220-volts D.C. with resistances and starters. Price £525 F.O.T. Southampton delivery ex site. Newman Industries, Ltd., Yate, Bristol.

Port of Melbourne Development Scheme

Striking Programme of Post-War Work

Below is reproduced from a recent issue of the *Melbourne Age*, which has just come to hand, a statement regarding the post-war plans of the Harbour Trust for the development of the port. It it is hoped in a future issue of this Journal to give fuller details of the proposals.

Melbourne Harbour Trust, which has set a standard for Australia in many aspects of port development, is preparing for an active part in post-war reconstruction. The Commissioners contemplate a scheme embodying not only the most modern conceptions from a utilitarian view-point, but a comprehensive provision for the comfort and convenience of ship passengers and other port communities, as well as regard to æsthetic considerations.

With an estimated expenditure of at least £4,000,000, these post-war works are expected to afford productive avenues by absorbing men for dredgers, hoppers and tugs, bridge builders, wharf carpenters, joiners, plumbers, painters, road and railway builders, riggers, motor drivers, steel workers, electricians and about a dozen other callings. The financial capacity of the Trust to undertake such a scheme is attributed by the Commissioners to sound fundamental planning by the earlier port engineers and subsequent good business management, in which, with assets now valued at £10,000,000, the loan indebtedness does not exceed £4,000,000. The post-war plans, drawn up by the present chairman and former Chief Engineer of Ports and Harbours (Mr. A. D. Mackenzie), were approved at a recent meeting of the Trust Commissioners.

Mr. Mackenzie forecast that air travel would undoubtedly lead to a decrease of shipping passenger traffic, mails and high-grade package transport, but such loss would be fractional compared with the huge volume of cargoes that, obviously, it would be uneconomical to carry by air. There would be fewer luxury liners of large tonnage, but a marked increase in the number of fast cargo liners and Diesel-engined vessels. Moreover, greater cargoes per ship would be carried to specific ports.

The percentage of vessels of deeper draught will increase. The new plans propose the widening, deepening and re-alignment of the river channel between Appleton Dock and Port Phillip Bay. The lowering of the sewer that passes beneath the river (already authorised) is to be followed by the deepening of the river; the river is to be widened, and the training wall works re-aligned. By an increase in river depths downstream from Appleton Dock much larger and deeper-draught vessels will be brought closer to the city and merchants' warehouses. The widening of the river will bring again into the picture the traffic tunnel project under the river in the vicinity of the Williamstown ferry.

Cargo Handling Plant.

A feature of new cargo-lifting equipment will be a 150-ton electric crane, which, with a floating crane, is expected to meet a demand for heavy lifts. In 1912, Melbourne had the first level luffing crane in an Australian port, and in 1926 the Commissioners imported the first Australian mobile crane. It is hoped that within three years of the end of the war the port will have fifty 3 and 5-ton level luffing wharf cranes. It is estimated that the saving of ships' time in port has meant the equivalent of several additional vesels afloat.

The number of berths equipped for mechanical discharging of coal are to be increased. All seaborne coal will be moved mechanically from the ships by conveyor belt to storage areas away from the wharf. Seventy-five per cent. of the wharf now exclusively receiving coal from ships' gear would be released. Heavy steel cargoes that may be expected in the expanding secondary industries and the city's post-war plans will be discharged by electric travelling wharf cranes and dealt with through a modern transit shed with overhead cranes and underslung jibs.

A new skyline of buildings as well as of cranes will greet the post-war passenger on vessels coming up river to the new river berths. At Appleton Dock the commodious transit sheds will have internal bridge cranes and other cargo-moving devices, roller shuters opening to the roads, and wharf aprons electrically operated. Passengers will be taken overhead from ship to reception areas by gangways of light metal alloys permiting of rapid movement following the berthing of a ship. Taxis and private vehicles are to be brought up to the upper passenger decks by ramped approach. A vehicle roundabout will be a feature of the upper platform. At Appleton "dockhead" a building of impressive appearance will house port navigation control staff, a marine inquiry bureau and modern amenities for all sections of the port community. This will include dining rooms, bath rooms and public refreshment rooms, run by private caterers by arrangement with the Trust.

Also proposed is the entire reconstruction of sheds and berths abutting Spencer-Street-bridge on both sides of the river. Here, too, double-decked structures combining appearance with utility will include dining room and office accommodation available for port users. Already, it is claimed, the port of Melbourne has done more in this direction than other Australian ports. The Trust's fleet of dredgers, the most powerful in the Commonwealth, is expected to keep channels ahead of all future shipping demands. Dredged material will be brought up for use in reclaiming waste land at Fisherman's Bend, Stony Creek and West Melbourne Swamp.

New Large Dry Dock.

For years the Trust has associated itself with the State in attempts to get the Commonwealth to establish a large dry dock at Melbourne. Such a dock would be valuable from a national point of view, and the Trust has always been prepared to make substantial financial contribution and to manage it. The eminent dock expert, Sir Leopold Saville, examined and approved Melbourne Trust's plans for a large graving dock. The Trust will include plans in the post-war scheme.

The proposed dry dock will involve considerable re-adjustment of the waterfront, with the reclamation of water areas and a relocation of certain industries and structures engaged in war work for which a water frontage is essential. Incidental to the task will be the displacement of the yacht mooring area. The new plans embrace a yacht base some distance from the developed commercial area of the waterfront. The Commissioners believe that proper facilities must be provided for Australian youth in the cultivation of "boat lore."

Other features of the plan include an extension of the Trust's housing scheme for employees by the acquisition of land near the port.

The construction of a fixed bridge to replace the old swing bridge over the Maribyrnong River at Napier Street, is to be submitted to the State Government for inclusion in a State post-war plan. Cost would be about £100,000.

Tribunal Awards in London Dock Disputes.

The National Arbitration Tribunal has recently issued awards in three cases of London disputes between employers and workers. Particulars of these awards, Nos. 463, 464 and 465, are obtainable (price 1d. each) from H. M. Stationery Office.

Cargo Pilferage at Chilean Port.

A complaint in regard to recent thefts of Bolivian goods lying in the port of Areca, Chile, has been the subject of investigation by a special commision. The report indicates that the main reason for these thefts and other irregularities is that craft containing goods have to anchor fully 500 yards off the pier and that after the goods have been put into barges, they remain more than 10 days in the bay before being sent on by rail to La Paz. The piers are also said to be much too small. Bolivian officials, moreover, are debarred from intervention owing to the fact that they are on foreign territory. Under a treaty signed in 1904, Bolivia lost direct access to the sea but was granted in compensation free right of transit across Chilean territory. The report is concluded with a recommendation by the Commission for an immediate improvement in the Chilean railway rolling stock which is in poor condition. It is also suggested that in order to obtain improved conditions, it is imperative for Bolivian officials to act more efficiently and for transit as a whole to be speeded up.